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U. S. COMMISSION OF FISH AND FISHERIES,
GEORGE M. BOWERS, Commissioner.

PART XXV.

REPORT

OF

THE COMMISSIONER

FOR

THE YEAR ENDING JUNE 30, 1899.

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1900.

A REVIEW OF THE FISHERIES IN THE CONTIGUOUS WATERS OF THE STATE OF WASHINGTON AND BRITISH COLUMBIA.

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INTRODUCTION.

From 1893 to 1896 the fisheries in the boundary waters between Canada and the United States were made the subject of inquiry by an international commission, composed of Dr. William Wakeham, of Ottawa, as the representative of Great Britain, and the writer acting on behalf of this country. The interesting region at the western terminus of the boundary line, where the fishing industry, though still comparatively new, has already attained a marvelous development, was visited in the summer of 1895, and several weeks were spent in examining its principal features. The results of this investigation, so far as they were directly pertinent to the objects of the commission, were embodied in its report submitted to the two respective governments on December 31, 1896.* Since then the writer has again gone over the voluminous notes made in the field not only by Dr. Wakeham and himself but also by various parties of the United States Fish Commission, including the work of the steamer *Albatross*, and has consulted the long series of reports published by the Canadian Department of Marine and Fisheries. The present paper is based upon the materials derived from these sources, and is limited in scope chiefly to those fishery questions of the region which are of international concern.

The fact most strikingly brought out in the assembling of these data is the great paucity of accurate or detailed information regarding the aquatic products of the region, such as is requisite in providing for their preservation while still permitting them to be utilized without needless interference. With exceptional opportunities for their study, resulting from the favorable conditions of environment, the field is one that would richly repay the inquiries of the naturalist and fishery expert, if properly directed, in the practical benefits they promise. After this explanation it is to be expected that the following pages will prove more serviceable in pointing out lines of profitable investigation than in setting forth the conditions which are actually known to exist, and while attention is called to the great variety of resources, these are enlarged upon only in the directions where their development has already made them prominent. It has also been possible in these same directions to indicate a few plausible means of safeguarding such resources, the suggestions in that regard being made in the full belief that ways can be found for rendering the fisheries as permanent a feature of any region as that of farming.

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* Message from the President of the United States relating to report of joint commissioners relative to the preservation of fisheries in waters contiguous to the United States and Canada. House of Representatives, Fifty-fourth Congress, second session, Doc. No. 315, pp. 178, Washington, Government Printing Office, 1897.

As the circumstances attending the rapid growth of the salmon fishery in the Puget Sound region of Washington since 1895 have not been made the subject of scientific investigation, and as only meager information regarding them has been obtainable, coming often from sources of doubtful authority, it has been impossible to deal with the recent history of the question in other than a very general way. The deductions here presented have, therefore, been chiefly based on the conditions found to exist in 1895, with such additions as seem certainly to be warranted.

PHYSICAL FEATURES.

At the western end of the international boundary line formed by the forty-ninth parallel of north latitude is a nearly landlocked sea, having especially noteworthy characteristics, the most important of which at present is its fishery wealth, shared in somewhat equal proportions by both Canada and the United States. This sea is elongate in shape and extends in a general northwest and southeast direction a distance of over 200 miles. Its southern end penetrates some 50 miles or more into the State of Washington, while its middle and northern parts lie between Vancouver Island, on the west, and the mainland of Washington and British Columbia, on the east. Having nowhere a width of over 35 miles, it is in some places much constricted and contains many islands which occupy the greatest relative area south of the boundary. Two passageways connect it with the ocean, a shorter and broader one, the Strait of Juan de Fuca, opening on the west, and a long series of irregular and mainly narrow channels leading northward.

There is no name, unfortunately, by which this body of water can be designated as a whole. Its northern part, chiefly in British territory, is called the Gulf or Strait of Georgia; the middle portion, largely occupied by the San Juan Islands, appears on the hydrographic charts as Washington Sound, although locally this name is scarcely recognized; while the southern part is known as Puget Sound, a term which is often popularly but incorrectly applied to the entire area within the limits of the State of Washington, exclusive of the Strait of Juan de Fuca.

Prominent characteristics of the sea are its abrupt shores, great depths and relatively low and equable temperature of water. The shore line is exceedingly irregular, being broken by innumerable bays, harbors, and deep inlets, is high and rugged in many parts, and backed by tall mountain ranges and occasional isolated peaks, all of which combine to produce a region of exceeding picturesqueness. The more open areas are the Gulf of Georgia and the waters at the inner end of the Strait of Fuca. The greater part of Puget Sound is divided into long, more or less winding passageways and inlets of medium to very narrow width, which, especially in its southern part, ramify in all directions.

The depth of water exceeds 200 fathoms in a few places, is above 100 fathoms over a wide extent, and seldom falls below 30 or 40 fathoms. This deep water is not alone characteristic of the open areas, but extends through the various channels at the south and reaches close upon the shores. In fact, there is practically no shallow water anywhere, except upon the few shoals and submerged rocks and upon the banks formed about the mouths of rivers by the sediment brought down at flood time. Its temperature seems never to reach 60° F., even in the summer, except in some of the more sheltered bays, the records showing mainly from 53° to 58°, and in the winter it is relatively high as compared with similar latitudes on the Atlantic coast. Under these conditions little is to be feared from local sources of pollution or other generally harmful agencies, and the effects of its rivers, however swollen and muddy during freshets, are for the most part quickly dissipated.

In its ruggedness, its depths, the temperature and purity of its waters, this sea partakes of the characteristics of the adjacent ocean, with which its strong tides maintain a constant interchange. It naturally follows that its fishes are those of the outer coast, which find here only somewhat greater shelter and perhaps a more convenient source of food. To the local fishermen it gives many advantages, convenient grounds, nearby harbors and markets, and those opportunities for fishing which belong especially with a broken sheet of water.

The region, both from its resources and from its natural advantages, is destined to have an important future. Its local products, which have thus far been most developed in the line of the fisheries, are sufficient to secure it great prominence, but its harbor facilities and convenient position with reference to Alaska and the Orient insure its becoming one of the most important commercial districts on the Pacific coast. The surrounding country is, in many sections, being rapidly settled, and while much unwarranted booming has taken place, a number of towns and cities have been established under conditions which make certain their future growth and prosperity. The most important of these in Washington are Seattle and Tacoma, whose commercial activity is already well marked. In British Columbia, Vancouver is the point of transshipment between the Canadian trunk line and the finest fleet of Pacific steamships; New Westminster, on the Fraser, is the headquarters of the salmon fisheries and canning, and Victoria is the principal British seaport. The development of trade and of local resources, not many years now past the stage of infancy, has been phenomenal, and is progressing year by year in an ever-increasing ratio. The recent gold excitement at the north has given a new impetus, but the fisheries, so long as they are preserved, will figure as one of the most valued features of the region.

This landlocked sea has only one large tributary stream, the Fraser River, which belongs entirely in British territory. With a single exception at the north, all other streams which enter from the east belong to the western drainage of the Cascade Range, and are therefore short and correspondingly unimportant. The Fraser is derived from several sources on the western side of the Rocky Mountains in the neighborhood of Yellowhead Pass. Flowing northwest about 190 miles through the deep valley between the Rockies and the Selkirks, it rounds the northern edge of the latter and thence continues southward about 470 miles, when it bends toward the west, completing in that direction the remaining 80 miles of its course. The total length of the Fraser is therefore in the neighborhood of 740 miles. There is one principal affluent, the Thompson, which joins it about 145 miles above its mouth, but of minor tributaries it has very many, ranging from medium size down, which are distributed throughout the system. Belonging with these, as a conspicuous feature of the system, are numerous lakes, generally elongate in shape, placed singly or in chains, which are mostly enlargements of the water-courses and have originated in the obstruction of channels by silt and coarser débris brought down by freshets derived from melting snow on the mountain sides.

The variable nature of the country through which the Fraser flows gives it a great diversity of characteristics, and in its passage through the Coast Range it has produced the celebrated canyon which bears its name. Its surroundings are in many places extremely wild and picturesque, but its lower 80 miles are through a flat, alluvial plain mainly deposited from its own silt, and about 10 miles above its mouth it divides to form a delta through which it reaches the Gulf of Georgia by two principal channels and several lesser ones. This plain affords rich farming land, much of which is under cultivation.

The river is navigable for vessels of ordinary draft a distance of about 80 miles from the sea, and for smaller craft about 60 miles farther. Its current is strong, increasing greatly in the season of freshets, the late spring and early summer, when it overflows its banks to a greater or less extent in the lower levels. This flood condition is chiefly caused by melting snow in the upper and tributary waters, and while varying in extent it seldom causes any appreciable damage, as dikes have been built around the farming lands. There have, however, been occasional extraordinary floods since the region has been settled, the most severe one on record having occurred the last of May and the first of June, 1894, when the river burst all bounds, covering the lowlands and valleys, sweeping away houses, and devastating crops. At this season the fishing is not important and its interests are not materially affected.

The upper limit of tidal influence in the river is in the neighborhood of Sumas, about 55 miles from the mouth, but brackish water is said not to be perceptible much if any above New Westminster. These limitations are for the spring tides during the periods of low water. The freshets counteract the influence of the sea in proportion to their height, and at their maximum carry the fresh water, at least on the surface, as far as the river mouths and into the Gulf of Georgia beyond. The ordinary rise and fall of the tide is about 12 feet at the mouth of the river and 4 or 5 feet at New Westminster.

A marked feature of the freshet season, having an important bearing on the salmon fishery, is the intense clouding of the river by sediment, a fine grayish silt, which remains long in suspension and gives a light slaty color to the water. The deposition of this material is going on continuously throughout the lower level portion of the river, causing shifting bars and banks, which, with their accompaniment of snags, are a source of great annoyance to navigation. But the silt is also carried out beyond the river, where it is adding to the delta formation and building up a wide bank or shoal along the shore, from Point Grey to Point Roberts. This bank is broadest directly in front of the river mouths, of which the principal ones maintain their channels through it into the deeper waters of the Gulf of Georgia.

In the early spring, when the quinnat begin to run, the river is comparatively clear, so that in the daytime the gill nets can be more or less plainly detected by the fish. Later the sediment appears and continues in all its intensity during June and July and into August, when the river begins to clarify. In the opaque water the nets may be used as effectively by daylight as at night, and it is during this season that the great sockeye run takes place, the run on which the canneries mainly depend for their immense pack. Day and night the nets are in the water, not only within the boundaries of the river, but over the outside bank and sometimes beyond its margins where the discolored water extends for several miles in all directions.

Aside from the Fraser there are numerous small rivers belonging to this drainage, of which the greater number and the larger ones are on the east side, taking their rise on the slopes of the Cascade Range. Those north of the Fraser are little known, but they end in large inlets. In Washington the most conspicuous is the Skagit, which is navigable for 60 miles, the other more important ones, beginning at the north, being the Nooksack, Stillaguamish, Snohomish, Dwamish, Puyallup, and Nisqually. These reproduce on a small scale the principal characteristics of the Fraser, the mountain features, the terminal lowlands, the deltas, and the flood season with its turbid waters. On the west side of Puget Sound and along the Strait of Juan de Fuca the streams are still smaller, scarcely more than creeks at the most, the highlands lying closer to the coast and greatly restricting the width of the drainage area. The inner side of Vancouver Island has only two rivers of any moment, the Cowichan and Nanaimo.

FISHERY RESOURCES.

The fishery resources of this region comprise a wide variety of products belonging to both the sea and its tributary fresh waters, many of which are exceedingly abundant and some of high commercial value. As is naturally to be expected, however, in a comparatively new country, still having a small population, the development of these resources has so far been directed mainly toward a few forms especially adapted for export trade.

In this respect the activities have been very marked during recent years and substantial progress has been made in building up a remunerative industry whose permanency may be insured by wise and conservative measures of control, even though its further growth should cause somewhat heavy drafts upon the stock. Still other lines promise good returns for the successful preparation of certain products suited for distant sale, but not until the region shall have become much more thickly settled can its rich fishery opportunities be measured at their full value. There is a host of species requiring near markets to be utilized, whose abundance is sufficient to contribute in due proportion toward the sustenance of an extensive population. As the time when such conditions may be expected to prevail is probably far distant, a large share of these resources must continue long in reserve, a guaranty for the future.

Besides its local resources the region should also have credit for its advantageous position in regard to fishing-grounds farther north along the coast, for which it is the nearest outlet, and with whose development it is sure to become most intimately associated. Its convenient harbors and railroad facilities give it superior facilities for the handling and transshipment of any catch that may be landed on its shore.

The salmon here, as elsewhere along the northwest coast, are the principal objects of fishery, no other group of species comparing with them in the extent and value of the catch. This results from their phenomenal abundance, the perfection to which their preparation has been carried, and, above all, from the firm hold which the canned product has secured in the markets throughout the world. Five species of *Oncorhynchus* and one of *Salmo* are represented, the quinnat, sockeye, silver, humpback, dog, and steelhead salmon. The quinnat is first in quality and, with the steelhead, stands most in favor for the fresh trade. Canners prefer the sockeye, and would use no other species could this one be obtained in sufficient numbers to satisfy their wants The remaining forms, after the common understanding of to-day, should probably be graded in the order given above. The silver salmon is most sought after, but all are utilized for canning—especially on the Washington side—and in other ways. It is a peculiarity of the sockeye or blueback salmon that it enters very few of the rivers of this region, while the other species distribute themselves quite generally and may be taken nearly everywhere.

The halibut should probably be accorded next place after the salmons, not so much on account of the local industry as for the fact that the entire halibut fishery from Cape Flattery to Alaska centers here. The local grounds are mainly distributed through the Strait of Juan de Fuca, and from its inner entrance north to Boundary Bay and south to the mouth of Hoods Canal. The most important nearby bank, however, is in the open sea off Cape Flattery, and other smaller banks lie directly south from there.

With the recent increased demand for halibut, the search for more extensive grounds was carried northward. The nearest one was located off the northern end of Vancouver Island in the vicinity of Cape Scott, but its area is restricted and its capacity relatively small. The most important grounds so far discovered are in Hecate Strait and its vicinity, and it is here that the principal catches have been made in recent years. They consist of numerous banks and patches, generally near the land, on both sides of the strait, the largest extending 60 miles along the northern side of Graham Island from North Island to Rose Point, and thence down the eastern side of Graham Island to the vicinity of White Cliffs. Among the islands of southeastern Alaska and about the southern end of Prince of Wales Island, small quantities of halibut are taken, but the Alaskan region is still open to development as regards this species.

While halibut fishing has always been one of the chief occupations of the Indians in the Strait of Juan de Fuca and the inner sea, the present status of the fishery has been the result of rapid growth dating back only about ten years, or to 1888, when it received its principal stimulus through the advent of two Gloucester vessels, which began fishing on Flattery Bank and in the adjacent region. Although the work of these vessels was not long continued, it gave evidence of abundant resources and led to the opening of markets even as far distant as Boston and Gloucester on the eastern coast, where the western product came directly into competition with that from the great Atlantic fishing grounds.

In 1890 the total catch from all sources landed in this region amounted to 1,376,800 pounds; in 1891 to 2,124,500 pounds; in 1892 to 2,768,000 pounds, and in 1895 to 4,251,000 pounds. The fleet, which had doubled in four years, consisted in 1895 of 48 boats of 5 to 10 tons measurement, of 10 vessels measuring from 18 to 40 tons, and of 3 steamers. Only the larger vessels and the steamers ventured as far as Cape Scott and the Queen Charlotte Islands. The steam vessels have belonged entirely in British Columbia, their catch being landed at Vancouver, Victoria, and Tacoma, and in 1895 having comprised a very large proportion of the total catch, but their operations are controlled by companies originating in the Eastern States.

Port Townsend was the first headquarters for the halibut fishery, but during the past few years Seattle and Tacoma, with their direct railroad communication, have absorbed nearly the entire business on the part of United States fishermen. Within two years, however, a few small shipments have been made from Fairhaven and New Whatcom. Fishing is carried on most extensively in the winter, and nearly all the catch is landed fresh, only an occasional trip being made for fletched halibut.

The main outlet for the Pacific catch is furnished by the Eastern markets, and is thus controlled by the large Eastern dealers, the shipments being mainly made at seasons when the Atlantic catch is smallest. The cost of transportation across the continent greatly reduces the profit to the catchers, who have to be satisfied with low prices, and who sometimes suffer considerable losses by producing more than the trade can handle. The demand, both at the East and in the interior of the country is said, however, to be constantly increasing, and, if heed be given to the condition of the market at different seasons, there is every reason to suppose that the development of the fishery may go forward steadily and without reverses.

While this fishery is assured a much larger growth, that it will ever approach the Atlantic fishery in extent or stand the same test of time seems improbable. The grounds in the Gulf of Georgia, Puget Sound, and Strait of Fuca, with those off Cape Flattery, have all together only a relatively small capacity, which has already been overtaxed. Along the British Columbian and southern Alaskan coast the continental platform is everywhere narrow, precluding the occurrence of extensive offshore grounds. On the Alaskan banks still farther north, made known through the cod fishermen and the investigations of the United States Fish Commission, halibut have not yet been found in the abundance characteristic of the North Atlantic, though further researches may show the conditions to be more favorable than now appears. But, however uncertain may be the future status of this important branch of fishing, the supply of halibut is undoubtedly sufficient to satisfy the demands of trade for a number of years to come.

While the true cod is of no importance as a local product, yet this region affords convenient shipping facilities in respect to the Alaska banks and will doubtless soon come to dispute with San Francisco for supremacy in their development. Two or more stations for curing and handling this species have already been established in Puget Sound.

Two species of sturgeon occur in these waters, the white sturgeon (*Acipenser transmontanus*) and the green sturgeon (*A. medirostris*), the former being the superior in quality and the only one utilized as food. It is exceedingly abundant, attains a very large size, and is regarded as one of the most important fishery products of the region. While probably ascending most rivers, it is best known on the Fraser, where alone it is now fished for regularly. Elsewhere in British Columbia and in the waters of Washington it forms only an incidental feature of the catch, so far as could be learned, a few finding their way to neighboring markets and some being sent inland. Many are sometimes captured in the salmon traps at Point Roberts, by which a part of the schools pass, apparently on their way to the Fraser River. The season of their movement there, however, seems to be mainly before the traps are set, in May and June, and those obtained are mostly secured during the latter month. The facilities for shipping from that place are so poor that no disposition was made of them until recently, but now a part of the catch is marketed.

Sturgeon are said to be present in the Fraser River at practically all times of the year, but to occur most numerously from midwinter until in June, during which period the fishery is carried on, the largest catches being made in April and May, when the principal run is understood to take place. The fishing-grounds most commonly resorted to are in the main river between New Westminster and Mission, and in Sumas and Harrison lakes. Formerly the sturgeon were taken on the Fraser River solely by the Indians for their own use, and incidentally in the salmon nets. It is only within a few years that a separate fishery has been established, but at present quite a number of persons, whites and Indians, engage in the business, using gill nets and hooks and lines. Both the meat and roe are utilized. The demand for export is increasing, and in the course of a few years it may be expected that the catch will be considerably enlarged.

The herring (*Clupea pallasii*) is one of the most abundant of the exclusively marine species of this coast, but is described as generally inferior in size and quality to the well-known Atlantic form. For this reason probably it is not in much demand for food, a limited quantity only being pickled and smoked, and a few disposed of fresh. It is, however, one of the most important baits of the region, and its value for that purpose may be expected to increase greatly with the development of the sea fisheries. It has also long been utilized for the manufacture of oil, but, while a considerable industry of this character was at one time carried on, the business seems at present to be of slight importance.

The dogfish is another species which has been extensively captured for its oil, and in this case, as with the herring, the fishery has declined, owing to the decreased value of this product, the fish being probably as abundant now as ever.

The eulachon or candle-fish enter the Fraser River in the spring in large numbers for spawning, and although the run continues for only a few weeks, a considerable fishery is carried on. They also resort to other rivers of the region, and may be taken in the salt waters, but the catch in the State of Washington is small. The amount obtained on the Fraser, owing in part to the shortness of the season, is said to be insufficient to meet the demands of even the local markets, which have to depend largely for their supplies upon the more northern rivers of British Columbia, where the species occurs in much greater abundance. Those obtained locally are mostly disposed of fresh, while the salted and smoked fish come mainly from the north. The Indian practice of extracting the fat or oil of the eulachon for domestic use is well known.

The smelt (*Osmerus thaleichthys*) and surf smelt (*Hypomesus pretiosus*) are both plentiful. The former, which measures only about 6 inches in length, is not of much importance for food, but the latter grows to the length of a foot, becomes very fat, and is greatly esteemed. It is already fished for quite extensively, but apparently for local use only.

Both the sardine (*Clupanodon cœruleus*) and the anchovy (*Engraulis mordax*) are inhabitants of these waters. The former, which has attracted considerable attention on the California coast, seems to be present here only during a brief period in the warmer part of the year. The anchovy, however, remains from May to November, is more abundant, occurring in immense schools, and is considered to offer an exceptional opportunity for the preparation of "sardines." A few, which were canned experimentally at Port Townsend, are said to have given great satisfaction. The species is now utilized to some extent both as food and bait.

The beshow or black-cod (*Anoplopoma fimbria*), which has received the high approval of many epicures, and for which an extensive fishery has been predicted by some, occurs in the inland waters, but is more abundant off the outer coast, where it also attains much the larger size. Up to the present time, however, it has been marketed only in small quantities and with no regularity, the catch being partly made in connection with the halibut. The very oily nature of the flesh makes its preparation difficult, and has undoubtedly retarded its introduction.

The cultus-cod (*Ophiodon elongatus*), although not ranking as a high-grade fish, has excellent qualities at certain seasons, is very abundant, and is one of the most common features of the catch among the exclusively salt-water species, being commonly sold in all the local markets. It has a wide range in the North Pacific Ocean, and attains a weight of 60 to 70 pounds. In this region it often goes by the name of cod and ling, to neither of which species, however, is it closely related.

The tomcod (*Microgadus proximus*), a small species, is also in considerable demand locally, and in some places is taken by the fishermen in large numbers.

Of the numerous species of rockfish (*Sebastodes*) which inhabit this region, several are of excellent quality and much esteemed. They are very plentiful, and during the winter are among the principal fishes sold fresh in the local markets. With the increase of population this group is certain to be largely drawn upon. The perches, as some of the viviparous surf fishes are called, are a cheap grade of fish, very common about the shores, and extensively utilized. Among the flounders with which these waters abound are several species of great excellence for food, but the demand for this class of fish is still limited and the catch is small.

The Atlantic shad, which has become well established on the Pacific coast through plants of fry made in the Columbia and Sacramento rivers, has worked its way north into Puget Sound and the Gulf of Georgia, where it is known to enter at least the Fraser and Skagit rivers. Not being specially fished for, information regarding its presence is chiefly based upon specimens caught incidentally and mainly in the salmon nets, which are not well adapted to its capture. It was first noticed in 1888 on the Fraser River, where in 1896 it had become sufficiently abundant to induce the fishery inspector to suggest regulations governing its capture. It seems bound to occupy a prominent place among the food-fishes of this region at no very distant time.

Trout of several varieties are distributed in abundance throughout the fresh waters, an attraction to anglers and a prospective source of profit when the country shall have become more thickly settled.

Aside from the sea otter, now extinct, the marine mammals have never figured prominently among the local fishery products, although some whaling has been carried on. The pelagic fur-seal fishery of the North Pacific Ocean, however, has chiefly centered in the ports of this region, furnishing employment to many hunters and producing a considerable revenue, but its continuance is no longer profitable, in whatever way its future may be settled by negotiations.

Among invertebrates this region is quite rich in edible mollusks and crustaceans. The small native oyster, while occurring in many places, is especially abundant in the shallow extensions of the southern part of Puget Sound, where the beds have recently been given some care and where quite an extensive business has been established. The introduction of the Atlantic species has been agitated and a few small plants have been made, but none of these has yet turned out successfully, so far as can be learned. Of clams there are several species of small to large size, some of which are exceedingly abundant and quite generally distributed. Although constituting an important resource, and esteemed both for food and bait, they have not been very extensively utilized up to the present time. Small quantities have been put up from time to time at one or more of the canneries. A large scallop and a cockle are also conspicuous among the useful mollusks.

Large crabs belonging to the genus *Cancer* are very common, and at certain seasons come up on the shores, in some localities in large numbers. They are in great demand for food and are eagerly sought for, although the total catch is small. The principal if not the only ground where they are now regularly fished for is the shallow bottom along the south shore of the Strait of Juan de Fuca between Dungeness and Port Williams. From there they are sent chiefly to Seattle, Tacoma, and Victoria, but not being fitted to stand a long shipment they are scarcely known at a distance from the coast.

Shrimps and prawns of good quality seem to be plentiful, but they are not much fished for, and little information regarding them could be obtained. The habits of these forms are such as to place them generally outside the ordinary range of observation, so that fishermen may be scarcely aware of their presence, when an active search might disclose them in abundance. At least two species of prawns are brought to market, one of rather large size, the other smaller. They have so far been taken principally about Victoria and in the southern part of Puget Sound, the catch being generally quite inadequate to satisfy the demand. The shrimps are much smaller and are not fished for.

THE SALMONS.

SOCKEYE SALMON.

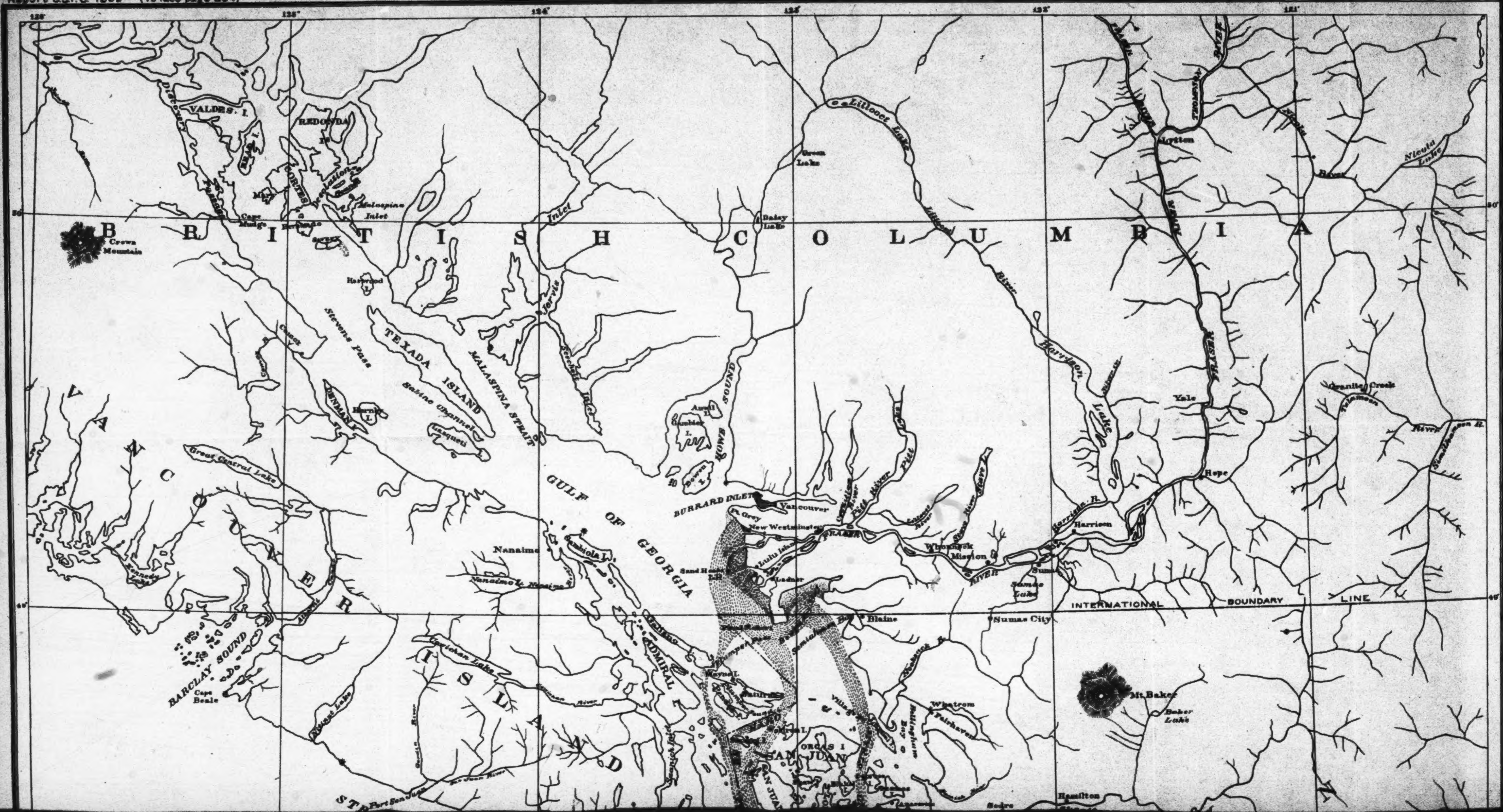
The sockeye salmon, as the blueback salmon or redfish, the *Oncorhynchus nerka* (Walbaum) of naturalists, is known in this region, is here much the most important of its tribe, being especially in demand for canning purposes, owing to the depth and stability of its color and the firmness of its flesh, although in edible qualities it ranks below the quinnat. It has, moreover, quite regular and well-defined movements, and, beginning to run at a comparatively early date, it affords a considerable fishery so far in advance of the spawning season as to insure an excellent quality of catch. Its size is also in its favor, being quite uniform. In the Fraser River it generally averages about 7 to 8 pounds, though sometimes weighing not over 6 pounds, and occasionally, but rarely, reaching 10 and even 12 pounds.

IN THE SALT WATER.

The sockeye which frequent the Gulf of Georgia and Puget Sound are supposed by the fishermen to enter from the ocean exclusively through the Strait of Juan de Fuca, and such few facts bearing upon the subject as have been collected tend to confirm this view. The species has never been observed in the upper part of the Gulf, and very rarely, if at all, to the north of Point Grey, at the entrance to Burrard Inlet. Some sockeye, which are said to average smaller than those of the Fraser River run, enter the passageway at the northern end of Vancouver Island and ascend the Nimkish River at Alert Bay, and possibly other small rivers in that locality, but none of these fish appear to reach the Gulf of Georgia.

On the outer coast, both to the north and south of the entrance to the Strait of Juan de Fuca, there are still other runs which are also distinguished by the smaller size of the fish, averaging from 4 to 5 pounds apiece. Very little is known regarding their abundance or habits, as the region is sparsely settled, but they are reported to enter only certain rivers, those having lakes in their upper courses. All of these rivers are small, but some of them, on the Vancouver Island coast at least, are apparently resorted to by sufficient quantities of fish for the maintenance of canneries on a small scale. Operations of this character were started in 1895 on Kennedy River, a short clear stream draining a lake of the same name and emptying into the southern end of Clayoquot Sound. The season there is said to correspond with that on the Fraser River, extending from early in July until the last of August, but south of Cape Flattery an earlier period is given for the commencement of the runs, though on somewhat doubtful authority.

All of the evidence collected goes to show that the sockeye entering the Gulf of Georgia and Puget Sound constitute a distinct run, which, approaching from the sea, throws off no schools toward the north or


126°
125°
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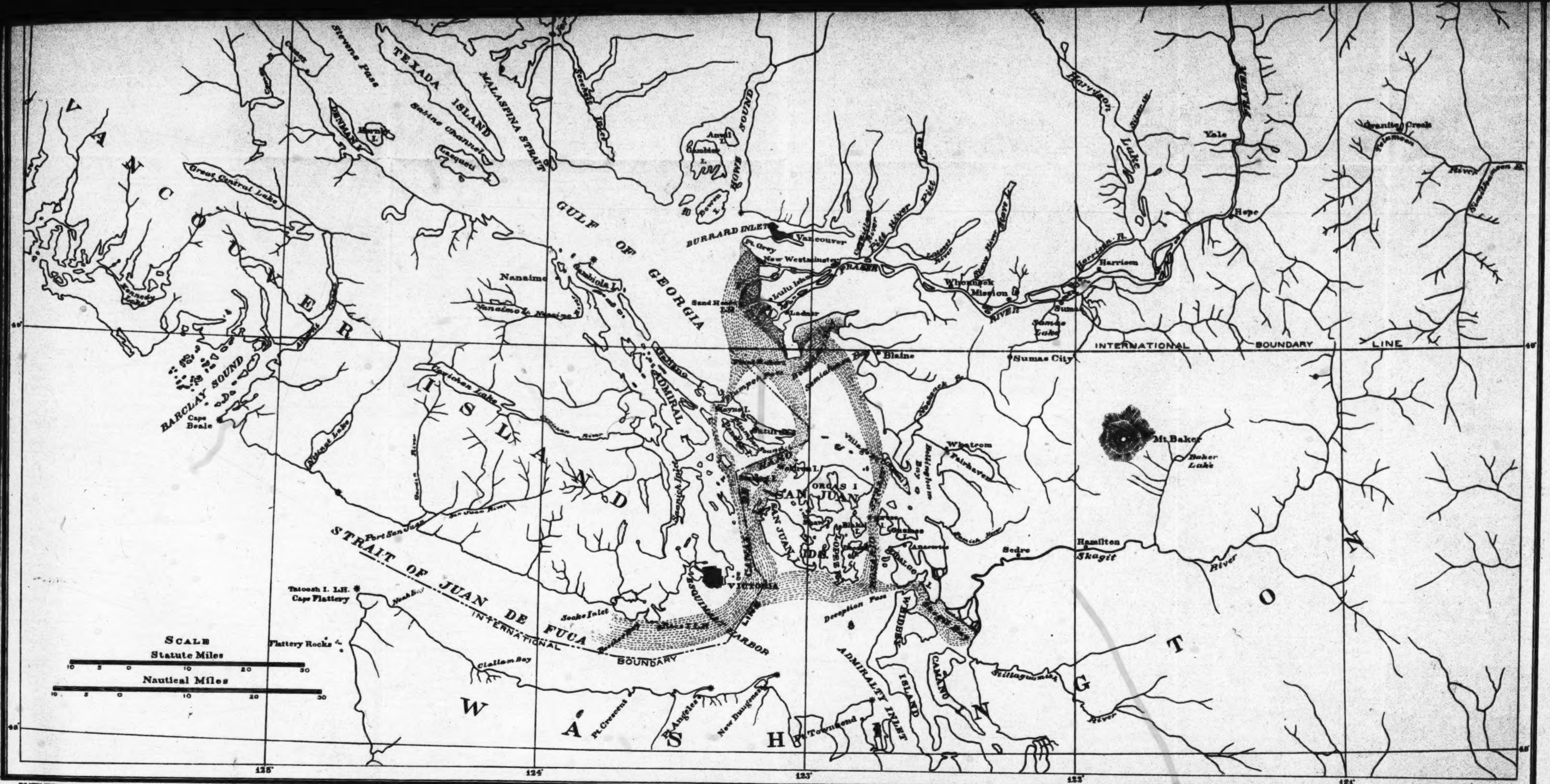
BRITISH COLUMBIA
VANCOUVER ISLAND
Crown Mountain
Discovery Passage
VALDES. I.
REDONDA Is
CORTES
Desolation Sound
Malaspina Inlet
Cape Mudge
Harwood I.
Comox
Stevens Pass
TEXADA ISLAND
Sabine Channel
Lasqueti I.
MALASPINA STRAIT
DENMAN I.
Hornby I.
Jervis Inlet
Sechelt Inlet
HOWE SOUND
Anvil I.
Gambier I.
Bowen I.
Daisy Lake
Green Lake
Lillooet Lake
Lillooet River
Harrison Lake
FRASER RIVER
Thompson River
Lytton
Nicola River
Nicola Lake
Yale
Hope
Granite Creek
Tulameen River
Similkameen R.
Great Central Lake
Kennedy Lake
BARCLAY SOUND
Cape Beale
Nanaimo
Nanaimo L.
Nanaimo R.
Gabriola I.
GULF OF GEORGIA
Cowichan Lake
Cowichan River
Nitinat Lake
San Juan River
Port San Juan
STR
Saanich Inlet
ADMIRAL
Mayne I.
Saturna I.
HARO
ORCAS I
SAN JUAN
BURRARD INLET
Vancouver
Pt. Grey
New Westminster
Lulu Island
Sand Heads L.H.
Ladner
Pitt River
Pitt Lake
Coquitlam River
Stave River
Stave L.
Whonnock
Mission
Harrison R.
Harrison
Sumas
Sumas Lake
INTERNATIONAL BOUNDARY LINE
Blaine
Semiahmoo Bay
Plumper Pass
Sumas City
Nooksack R.
Whatcom
Fairhaven
Bellingham Bay
Mt. Baker
Baker Lake
Hamilton
Sedro
Anacortes



SKETCH MAP SHOWING APPROXIMATE ROUTE OF THE SOCKEYE SALMON IN APPROACHING THE FRASER RIVER AND SKAGIT RIVER FROM THE STRAIT OF JUAN DE FUCA south, but passes directly and in successive bodies through the Strait of Juan de Fuca toward the spawning-grounds. During their passage up the strait at least the bulk of the fish appears to keep in the deeper water or below the surface until approaching the vicinity of Victoria. At any rate, notwithstanding some statements to the contrary, no reliable evidence has been secured indicating that this species has been seen or captured farther west. In view of the number of fishing and other craft which navigate this channel, and the diligent manner in which the sockeye have been searched for in several localities, it would be strange if their occurrence in any numbers could have been overlooked. Further observations, however, may disprove this conclusion. A run of sockeye is said to enter Port San Juan, opposite Neah Bay, but it evidently belongs to the coastwise schools of smaller fish.

The place where the fish are first known to disclose themselves is at the southeastern corner of Vancouver Island, between Sooke Inlet and Becher Bay, and here the Indians begin their capture, though their fishery is a very small one. This point is regarded rather in the light of a signal station from which the approach of the first as also of the succeeding bodies is heralded to the more important stations farther along their course. News from Becher Bay is anxiously awaited, and its receipt hastens the final preparations for the large and active fishery which immediately follows.

They next appear off Race Rocks, where, however, the tidal currents are so strong that fishing operations have never been successfully carried on.

Having completed their journey through the strait the great bulk of the sockeye turn northward, having the Fraser River as their destination, the number which enters the fresh waters in the State of Washington being relatively small. In their movement north the schools divide or separate, so as to make use of the two principal channels on either side of the San Juan Islands, the Canal de Haro and Rosario Strait, but they avoid the narrower passageways between these islands.

In the Canal de Haro the sockeye have been noticed at several points along the shore of San Juan Island, especially off Kanaka Bay and in the neighborhood of Henry Island, but all attempts at fishing in this section by the whites have so far met with indifferent success. The Indians take them in their reef nets about Stuart Island, and they have been recorded from off Saturna Island. It is probable that the main run works into the Gulf of Georgia through the wider channels between these islands, but it is also certain that a considerable body makes use of Plumper or Active Pass, between Mayne and Galiano islands, which is the most direct route to the Fraser River mouths. It is said, however, that no sockeye pass to the west of Salt Spring or Admiral Island, and the species is understood to avoid entirely the eastern coast and eastern rivers of Vancouver Island.

The sockeye making for Rosario Strait strike in abundantly off Cattle Point, at the southeastern corner of San Juan Island, furnishing opportunities for trap-net fishing, and also off the southern end of Lopez Island, directly east of San Juan Channel entrance, where for many years the Indians have made successful catches on the kelp-covered reefs. From near this point an offshoot of the run makes through Deception Pass into Skagit Bay and thence reaches the Skagit River, which, so far as known, is the only stream in this part of Washington which the sockeye enter in appreciable numbers, but the quantity is much smaller than in the Fraser River. Some sockeye work farther south, but where they leave the main run is not known and the quantity that moves in that direction is insignificant. They have never been reported from the salt waters of Puget Sound south of the neighborhood of the San Juan Islands, but have been observed in one or more of the small rivers which empty into it in that region.

The main eastern run, after passing around the southern end of the San Juan group, proceeds up through Rosario Strait and along the mainland of Washington to Boundary Bay and Point Roberts. During the first part of this movement, however, the fish seem to keep mostly out of sight, to the great bewilderment of the fishermen, who have been much puzzled at their failure to find good places for intercepting them. They have been reported in small quantities at the entrance to Bellingham Bay, but in Rosario Strait there are no distinctive places where they have been noticed abundantly before reaching the northern end of Lummi Island. Here they strike directly on the outer shore south of Village Point, where there is an important fishing-ground, both for reef nets and traps, which has long been resorted to by the Indians. Thence northward along the mainland shore as far as Boundary Bay they appear at intervals, but while nets have been set for their capture on some of the more prominent points, none of these had given satisfaction up to 1895, but whether on account of faulty construction or the scarcity of fish was not learned. The fishermen, however, have been encouraged to renewed attempts in this section and may yet succeed.

Boundary Bay and the waters about Point Roberts constitute a grand parade-ground of the sockeye, as it is here that the species uncovers itself in the greatest numbers in the salt water and to the best advantage for its pursuers. The quantity that appears at times is very large, and the catch may be enormous. The abrupt bending of the coast line toward the west in this locality interposes a barrier directly across the pathway of the fish, suddenly checking their progress toward the north and obliging them to make a sharp detour in order to complete their passage to the Fraser River. They enter Boundary Bay apparently in a broad front, and then turn westward, sweeping around Point Roberts. The nearness of their approach to land depends upon the depth of water and the direction of the wind. A southerly wind tends to drive them farther in the bay, while a northerly wind holds them out. They may enter the bay as far as the edge of the flats, thus crossing the boundary line to a slight extent, but the small catches made in the inner traps, and then only under the most favorable conditions, indicate their natural tendency to avoid the shallower water. Along the southern side of Point Roberts the much bolder shore permits the fish to come within a few yards of the beach, and this is also true for a short distance on the outer side, after rounding the southwest corner; but then soon begins the shoal or flat, which widens rapidly to form the extensive bank commanding the approaches to the Fraser River.

Much remains to be learned regarding the later as well as the earlier stages in the movement of the sockeye which pass through Rosario Strait. While the appearance of extensive schools in Boundary Bay and about Point Roberts is definitely established through the experiences of the fishermen, it can not be said that the entire eastern run approaches those localities so as to come within the range of observation, and it is very possible that some of the schools make the passage to the Fraser River at some little distance from the land. In fact, judging from the statements of the fishermen, when large bodies of fish are moving around the point they occupy a wide zone, extending some distance off shore and beyond the limits of the trap nets. The latter are, therefore, said to intercept only a very small proportion of the run, notwithstanding the amount of ground they cover. The schools on which the fishermen depend are chiefly those which enter well within the bay and, then circling, pass directly in front and within a mile or slightly more of the southeast corner of Point Roberts, called Cannery Point, which carries them over or around the large kelp-covered ledge south of that point. Their course is thence along the southern side of Point Roberts, keeping well in until they have rounded the southwest corner, when they begin to follow the edge of Roberts Bank (so called), over the deeper parts of which they soon become distributed.

The meeting-place of the two divisions of the sockeye run—one coming through the Canal de Haro, the other through Rosario Strait—is not known. Both are seeking the fresh water of the Fraser River and begin to feel its influence some distance off the shore. The flood which begins in the late spring continues during most of the summer, so swelling the volume of the river and charging it with fine sediment that the brackish and discolored water is carried a long way out into the Gulf of Georgia and covers, during practically the entire sockeye season, a relatively wide area. In this mixed water both runs assemble preparatory to ascending the river. It is also a common belief among the fishermen that they rest here for several days, or at least that all do not immediately begin the inland journey. While there is as yet no positive proof of this, it is not out of keeping with the habit of some of the salmon species elsewhere, and the prolonged periods of fishing which are enjoyed in this position make it appear at least reasonable. The extent of this assembling-ground, as brought out by the recent drift-net fishery, is from the neighborhood of Point Grey to about the boundary line, while off shore it seems to reach beyond the margin of the bank and even at times to the middle of the gulf, if the fishermen's accounts can be regarded as reliable. It is also reported, though the fact is not definitely confirmed, that occasionally a few of the fish work around Point Grey into Burrard Inlet.

Scarcely anything has been learned of the general habits of the sockeye in salt water. They take neither food nor bait and therefore lack the game qualities of the quinnat and the silver salmon. Unlike those two species, their salt-water home is exclusively in the open ocean off the outer coast. When they enter the Strait of Fuca they are bound by the shortest routes to their spawning-grounds, and if they tarry on the way it is only for short stops in the manner described above. The Strait of Juan de Fuca, Puget Sound, and the Gulf of Georgia are to them practically only enlargements of the river, through which they must necessarily pass, but in which they have no special functions to perform. The adult fish occur there only during the period of ascent, the season when they are fished for, July and August mainly. They appear to move in compact, defined bodies, of smaller or larger size, sometimes very extensive, another evidence of their transitory presence. Occasionally these schools appear at the surface, as has been especially reported at Point Roberts, but usually they remain lower down, although they may even then be seen at times in the clear waters, particularly when they are passing over the shallow kelp-covered ledges, which seems to be one of their delights, and which exposes them to capture by the Indian nets.

Statements regarding the rate of their movement in the salt water are greatly at variance, as is to be expected from the crude opportunities for observation up to the present time. Varying conditions, due to the season and the weather, are very likely to cause a difference in this respect. Schools reported at Becher Bay are said sometimes to make the Fraser River in five days, while again they may be as much as two weeks on the way. They may be taken at Point Roberts twenty-four hours before they are noticed off the Fraser River, or they may first be observed simultaneously at both of these places.

FRESH-WATER DISTRIBUTION.

The Fraser is the only river of British Columbia emptying into the Gulf of Georgia which the sockeye are known to ascend. In Washington this species seems to enter only the Skagit River in sufficient quantities for commercial purposes. It has been reported in very small numbers from Lake Washington at Seattle, but elsewhere in the fresh waters of the Puget Sound region its occurrence has never been positively recorded.

Skagit River.—The number of sockeye ascending the Skagit River seems to be considerable, although the run is in no way comparable with that on the Fraser River. They enter the former river by way of Deception Pass and Skagit Bay. Fishing is mainly carried on in the bay, where both trap nets and gill nets are employed. In the river the principal fishermen have been the Indians, whose operations have been chiefly limited to the vicinity of Baker Falls, but some fishing is also carried on by the whites. Up to 1895 this species was taken only in relatively small quantities either in the bay or river, but the establishment of canneries at Anacortes since then has greatly stimulated the efforts for its capture, causing a rapid development of the fishery. No details of its growth are at hand, but the size of the catch has apparently been much increased.

The only spawning-grounds which have so far been located in the Skagit River are at Baker Lake, on the tributary of the same name, having its origin on the slopes of Mount Baker. It is the general opinion that the entire run turns up Baker River and that it ascends no farther than the lake, but this supposition is not yet entirely confirmed. The inquiries already made, however, indicate that Baker Lake contains one of the most important spawning-grounds of the sockeye known to exist in the United States, and advantage has recently been taken of that fact to begin its artificial propagation in that locality.

It is reported that the sockeye begin to be taken at Baker Falls, near the mouth of Baker River, as early as the middle of June, but this so far antedates the time of their appearance elsewhere in the region that the evidence seems to be in error. They are also said to reach Baker Lake chiefly during July, and to begin spawning the last of August or early in September. The hatchery on Baker Lake was established by the State of Washington in 1896. The first eggs were taken on September 6 of that year and the last on October 8, when the capacity of the hatchery was reached, the total number obtained being 6,500,000. The season had not closed, however, by the latter date, and it was thought that fully twice that number might have been secured had there been means for caring for them. The number of fry obtained from the above eggs and planted in the spring of 1897 was 5,500,000. The output of fry in the spring of 1898 was 6,000,000, and 7,500,000 eggs were collected in the fall of that year.

In his account of this subject for 1898, the fish commissioner of Washington states that Baker Lake is about 1¾ miles long by 1½ miles wide, and has two principal inlets, Sutter River and Noisy Creek. The spawning-places of the sockeye occur in the lake and in both of these streams. The silver salmon and steelhead also run up to this locality in large numbers, and the quinnat appears here, though to a less extent.

Fraser River.—From the bank in front of the delta, where they first assemble, the sockeye pass into the Fraser River through both entrances, the main channel and the north arm, including also Canoe Pass, a short offshoot of the former. The relative proportion which enters each is said by the fishermen to vary considerably in different years, as well as in different parts of the same season, but their evidence in this regard is quite indefinite. They claim, however, that at times as good fishing may be had in Canoe Pass as in the main channel, through which the greater number might naturally be expected to make their way, as probably they do.

The species seems to distribute itself very generally throughout this river system, attaining the headwaters of its principal branches and entering a large proportion, if not the greater number, of its side tributaries, both large and small. During the years when the larger runs occur they make their appearance in many of these streams in extraordinary abundance. Pitt River, not far above New Westminster, is said to contain their nearest spawning-grounds to the sea, but the quantity which enters this stream is relatively small. Other lower tributaries which later runs ascend are Harrison River and Lake, Morris River, and Silver Creek.

Our knowledge of the season and movements of the sockeye in the Fraser River is based mainly upon the experience of the fishermen and canners, supplemented by the evidence of officers of the Canadian government connected with hatching operations and the fishery police. Scientific observations are wholly lacking, and it is therefore impossible to speak with confidence in regard to more than the main features of the subject. There is considerable variation in the date of beginning and ending of the season, the fish appearing and completing their movement earlier in some years than in others, although there may be more or less agreement in this respect during two or more succeeding years, followed by a marked change. It has been reported that a few sockeye sometimes work up the river in the latter part of May, but the testimony to this effect is of doubtful value. The fact is well established, however, that the species occasionally appears in small numbers during the last few days of June. Moderate runs may occur as early as July 4, but they are not generally expected in sufficient quantities to start fishing operations before the 10th of July, and even up to that date they may still be practically absent. By July 20 they should be running as heavily as they will at any time. A large run may occasionally take place at the very end of August, but the average fishing season ends somewhere about the 20th to the 25th of August, and years are recalled when nothing could be done after the first week of that month. Small numbers usually continue present during more or less of the early part of September, but with the near approach of the spawning period the fish rapidly deteriorate in appearance and condition and lose their commercial value.

The fishermen are inclined to recognize two distinct runs after the movement has fully begun, these being separated by a few days of poor fishing. This view, however, is not in accordance with the facts. There is, from the beginning of the season, a more or less constant fluctuation in the abundance of the fish. Larger bodies come from time to time, the quantity diminishing more or less in the intervals between, while frequently the fish become very scarce or may be entirely absent. There is no regularity in the matter and nothing on which the fishermen can depend. There are good years and off years, as they are called, following one another in a certain order, as elsewhere described, but even in an off year very successful catches may unexpectedly be made. The year 1895 belonged in the latter category, and during short periods some single boats took as many as 450 sockeye daily with their one drift net, while catches of 200 to 300 fish a day were made by many boats. During most of the season, however, the catches averaged no more than 25 sockeye daily to a boat, being often smaller, and frequently none was secured.

When the number of boats engaged in this fishery is taken into consideration, one comes to realize how great is the quantity of sockeye entering this river system, and how relatively compact at times must be the distinctive bodies moving upstream. With the appearance of the latter the catch suddenly increases, often to such an extent as to give the canneries much more than they can handle, and the excess is occasionally so great as to cause an enormous loss of fish. No other species of salmon is so abundant in the Fraser as the sockeye.

Observations which seem reliable indicate that, in a general way at least, the earlier runs proceed farthest up the river. The fish composing them are less mature when entering from the sea than those of the later runs and are better prepared to make the longer journey. Sockeye have been seen in abundance in the streams which empty into the South Thompson and in the Shuswap Lakes about the middle of July, yet on returning to the Harrison and other lower tributaries their total absence there was determined. It is on the later fish, eagerly seeking the nearest spawning-grounds, and with their reproductive organs well developed as they move upstream, that the Canadian hatchery relies for its supply of eggs. These are the runs which have been most closely observed and are best known.

The sockeye retains its freshness in the river longer than any other species of salmon except the quinnat and the steelhead. This must be chiefly due to the fact that its movement begins quite far in advance of the spawning season, and during nearly the entire period of its run through the lower part of the river the catch is always of a superior character, the flesh being firm and of good color, while the external surface is clean and inviting in appearance. Beginning the latter part of August, however, the fish rapidly deteriorate in condition, and the close season, which begins on August 25, is as much in the interest of the consumer as for the protection of the species. In 1894, by request, the Canadian government extended the open season a week longer on the plea that the sockeye were late in beginning to run, owing to the heavy flood which occurred in the early part of the summer. Such was probably not the fact, although the high water interfered with fishing operations, and the spawning season began no later than in average years. The extension was therefore deprecated by those having the best interests of the fishery at heart, and it is not likely to be repeated.

Whatever may be their stay in the brackish water outside the delta, when once inside the river their progress upstream appears to be quite rapid and continuous, if one may judge from the experience of the gill-netters, especially in connection with the weekly close time, which permits the rate of movement to be roughly measured. These observations relate to the main part of the river, and more particularly to that portion where commercial fishing is carried on, but the movement doubtless continues at much the same rate until the fish are in the neighborhood of their spawning-grounds.

The depth at which they swim while ascending the lower part of the river, where its volume is greatest and where the water is sometimes deep, is said to vary with the conditions. When the water is very muddy the fish are expected to keep nearer the surface than when it is more or less clear, and as the former condition prevails during practically the entire sockeye season, the depth of about 50 meshes adopted for the drift nets has been found to be as great as can both profitably and conveniently be used. In deep parts of the river more fish are taken at the sides than in midstream, and the same is true during times of flood. In shallow sections and during low water they spread out more widely, becoming more generally distributed or finding their way where the contour of the bottom affords the depths preferred.

PROPAGATION.

The sockeye and quinnat are understood to have substantially the same spawning season, which, in the Fraser River, is mainly from the middle of September to the middle or latter part of October, although beginning, in some seasons at least, a little earlier and continuing to a somewhat later date. It is supposed that the season is about uniform in all parts of the system, although nothing positive is known about the dates in the upper waters.

According to the late Thomas Mowat, for some time fishery inspector for British Columbia, the sockeye, as a rule, spawn in the small creeks that flow into the lakes and larger rivers, very few depositing their eggs in heavy, rapid streams, as the quinnat do. This is essentially in keeping with observations made elsewhere. At Karluk, Alaska, Dr. Bean found this species spawning in the main lake and in the short and rapid streams connecting each of its arms with smaller lakes. The spawning-grounds at the headwaters of the Columbia River, in Idaho, which have been carefully studied by Professor Evermann, occur only in streams tributary to the lakes or in the lakes themselves.

In 1884 the Canadian Government began the propagation of salmon on the Fraser River, at the solicitation of local canners and fishermen, who suggested a system of license fees and of taxes on the prepared products as a means of obtaining revenue for the purpose. The hatchery was established in the neighborhood of New Westminster, being completed in time to lay in a stock of that season's eggs, and was retained at the original site until about 1894, when it was removed to a place nearer the collecting-grounds. Attention was paid in the beginning to both the sockeye and quinnat. With regard to the former species, it was hoped to more nearly equalize the annual runs, the great diversity of which is described further on. As to the latter, it was desired not only to increase the supply, but also to introduce the more desirable grade from the Columbia River. The propagation of the quinnat was continued during only five years, however, and was restricted to native stock, the output of fry never exceeding about 2,000,000 in any one season.

The hatching of sockeye, started at the same time, has been continued down to date. The eggs have been mainly secured in Morris Creek, a tributary of Harrison River, the parent fish being caught and held in captivity until the spawn ripened. While the quantity of eggs to a female has been calculated at about 5,000 on an average, the number actually obtained from each has averaged only about 3,000 to 3,500, owing to the fact that, being mostly taken during the progress of the spawning season, many of them are more or less spent when they reach the pens in which they are confined.

The collecting season has varied in different years, beginning in some as early as the middle of September and in others not until about October 8, and ending all the way from October 15 to the first part of November. The period of incubation is relatively short, the fry being produced and planted during March and April following. With few exceptions the plantings have all been made in lower tributaries of the Fraser River, such as the Harrison, Stave, Little Lillooet, Pitt, and Coquitlan rivers. Between 1885 and 1890 relatively small numbers of fry and of semi-hatched eggs were placed in the Cowichan and Nanaimo rivers, of Vancouver Island, neither of which are natural sockeye streams, but so far as can be ascertained this effort at transplanting has met with no success.

The total number of sockeye eggs collected and the number of fry deposited in the Fraser River during each year since the establishment of the hatchery are shown in the following table, in connection with which it will be understood that the fry planted in any one year were derived from the eggs of the previous year:

Table showing the total number of eggs of the sockeye salmon collected and the number of fry deposited in the Fraser River from 1884 to 1897.

Year.	Number of eggs collected.	Number of fry deposited in the Fraser River.	Year.	Number of eggs collected.	Number of fry deposited in the Fraser River.
1884	250,000	....	1892	6,237,000	5,600,000
1885	1,487,000	?	1893	6,890,000	5,764,000
1886	4,780,000	?	1894	6,752,000	6,300,000
1887	9,325,000	2,405,000	1895	6,830,000	6,390,000
1888	4,000,000?	3,870,000	1896	6,770,000	6,388,000
1889	9,228,000	4,046,500	1897	6,472,000	5,928,000
1890	3,861,000	5,540,000	1898	....	5,850,000
1891	6,485,000	3,608,000	1899	....	5,500,000

Of the young of the sockeye little could be learned, and nothing of special interest. After hatching they are said to remain in the several tributaries until about June of the following year. A few grilse are reported to be taken occasionally in the river as well as in the salt water, but some question must attach to the identification of the specimens thus captured until they have been critically examined.

The initial steps toward the propagation of the sockeye on the Skagit River have been described in connection with that river, while the question as to what benefits may have been derived from the hatching on the Frazer River is discussed under the heading of periodicity, which follows.

PERIODICITY IN ABUNDANCE.

A periodicity in the abundance of the sockeye in alternating cycles of four years' duration has been recognized in this region ever since the first settlements were made upon the headwaters of the Fraser River by the Northwest Company in 1806. The species has been shown to attain its maximum abundance in every fourth year. The next season's run, while inferior, is expected also to be a good one, but those of the two following years should be relatively small. There is no question but that this fluctuation has occurred and that the sequence has been in accordance with the explanation given, but no standard can be fixed for measuring the extent of the variation. The differences, however, have been sufficiently great and regular not only to attract attention, but also markedly to affect the fishery and the canning industry. The canners have been enabled to anticipate in large measure the conditions of each approaching season, and to plan accordingly, thus regulating the extent of their preparations.

The statistics of the fishery alone do not furnish a suitable basis for determining either the occurrence or the regularity of this periodic variation, owing to the fact that the extent of the catch has often been influenced by the state of the market or the depression of trade. Thus, in the good years packers may have been led to greatly reduce their output, causing a shortage in the catch, while in poor years an active demand may have induced the fishermen to largely increase their operations. From information given in the official Canadian reports it has been possible to supplement the statistics by evidence as to whether the fish were actually abundant or scarce in any year, irrespective of the amounts captured in the nets, and while fine distinctions can not be drawn from this source the data seem to be sufficient to test approximately the correctness of the alleged periodic changes.

These facts have been brought out in the following table, in which the anticipated and actual conditions are shown for each year from 1877 to 1898. For reasons already explained it has been impossible to use other than very general terms to express these conditions, but they will undoubtedly serve the purpose here desired. The recurring cycles are indicated by the numbers in the second column, number one in each cycle standing for the year of maximum abundance.

Table showing the anticipated and actual conditions regarding the relative abundance of sockeye salmon for each year from 1877 to 1898, in illustration of the subject of periodic fluctuation.

Year.	Cycles.	Anticipated conditions.	Actual conditions.	Year.	Cycles.	Anticipated conditions.	Actual conditions.
1877	1	Good	Good.	1888	4	Poor	Very poor.
1878	2	do	Do.	1889	1	Good	Good.
1879	3	Poor	Poor.	1890	2	do	Do.
1880	4	do	Do.	1891	3	Poor	Fair.
1881	1	Good	Good.	1892	4	do	Poor.
1882	2	do	Do.	1893	1	Good	Good.
1883	3	Poor	Poor.	1894	2	do	Do.
1884	4	do	Do.	1895	3	Poor	Do.
1885	1	Good	Good.	1896	4	do	Do.
1886	2	do	Fell short.	1897	1	Good	Do.
1887	3	Poor	Good.	1898	2	do	Poor.

From an inspection of the table a correspondence will be noticed in the anticipated and actual fluctuations for every year down to 1885, inclusive. In 1886 the quantity fell much short of expectations, although the catch was kept up by an increase in the number of nets employed, and in 1887, which should have been a poor year, the run was better than in 1886. In 1895, also theoretically a poor year, the run was above the average, while in 1896, expected to be the poorest of its cycle, the catch is recorded as the third largest in the Fraser River fishery down to that time. As a whole, there were few measurable differences from the anticipated conditions down to 1892, since which time good runs have occurred during practically five continuous years. In 1898, however, which should have been a good year, the catch was relatively small.

The run of 1897 was one of the largest if not the largest in the history of the region. Preparations had been made in anticipation of a good year, both on the Fraser River and in Washington. The great body of sockeye first made its appearance about the middle of July and continued until about the end of the first week in August, a relatively short season, but during this period the cannery pack was completed and in addition an immense amount of fish was thrown away, the daily catch being often much larger than could be disposed of. It has, in fact, been claimed, though this is probably an exaggeration, that more fish were caught and wasted than were utilized. Where contracts had not previously been made, the canneries soon found it necessary to refuse much of the fish offered them, thus depriving many fishermen of their occupation through the very abundance of the objects of their pursuit. At Boundary Bay it is said that the traps filled faster than they could be emptied, while some of the gill-netters caught fully 1,200 salmon to a net in a single night, and many from 500 to 1,000 each. On the Fraser River the individual catches were in proportion.

While in 1897 the bulk of the catch was made early, the height of the season varies in different years. In 1890 and 1896, both of which were good years, the boats all made very small catches on the Fraser River until about August 10, when the fish began to run abundantly, raising the average daily catch per boat to from 200 to 500. In those years also, as well as in some preceding ones, the canneries became overstocked and many sockeye were destroyed. The catch of 1889 was likewise an unusual one, some of the contract fishermen earning as high as $1,500 during the season.

Several theories have been advanced to account for the periodicity in the abundance of the sockeye, which all seem willing to admit has continued, with at least some measure of regularity, down to within about a decade, but none of them is yet supported by conclusive evidence. An explanation is rendered easier if it be assumed that the sockeye makes but one spawning run, which seems in the main to be an established fact, and that its age at that time is four years, a point, however, which has not yet been determined from other evidence. On this basis, the size of any run having been established, the run of four years later, composed of its own progeny, might be expected to be of corresponding size; a large run to give origin to a large one, and a small run to a small one. The size of the initial runs, at whatever dates they are started, and the subsequent fluctuations in their size may readily be accounted for by the many vicissitudes which belong to fish life from the egg and embryo stages to adult age. Years of favoring conditions alternate in irregular sequence with those in which the conditions are adverse, and both at sea and about the spawning-grounds contingencies arise which may seriously affect or change the volume of any season's run.

Some of the greatest dangers of destruction undoubtedly exist in the spawning areas, where the eggs and the embryos are subject to much damage through the cold of winter, the force of freshets, and the washing of silt and gravel in upon the beds, and from one or other of these causes a large mortality must occur. Other agencies to be considered are the fisheries, both commercial and by the Indians, which remove a large amount of fish, but it seems improbable that either of these could be made to account for the periodic fluctuations. This is especially so as regards the white man's fishing, which did not become extensive until many years after the variations had been recognized, and in spite of which the sockeye seem to be no less abundant now than in early times. While the Indian methods and the extent of their captures are more likely to have had a bearing on the case, it seems more natural that their fishing should have affected all runs alike.

As before noted, one of the principal objects in establishing a hatchery on the Fraser River was to attempt to equalize the runs of sockeye, to make this species more abundant in off years, and thus, if possible, to provide good fishing every season. From the testimony of the local officers and fishermen, and even from the statistics of the last few years, it would appear as though something may have been accomplished in this direction.

In 1889 Fishery Inspector Mowat reported that the parent sockeye had become more plentiful in the small creeks where the fry had been deposited, and thought the increase in Morris Creek had been tenfold, as in 1885 and 1886 they could scarcely secure any fish there, while in 1889 they caught them numerously. This explanation of the increase is scarcely tenable, as the number of fry set free in 1886 was not above 1,000,000—less, had they all survived, than one-third the total Fraser River catch of 1887. Mr. Mowat, moreover, attributed the good catch of 1887, which ranked as an off year, to the same cause, but this would have allowed for only three years' growth from the time the first eggs were taken (not hatched), and the total number of those eggs was only 250,000.

It is to the last few years that we must look for the most positive evidences of the success or failure of hatching operations, following the steady planting for a decade and over, and while the quantity of fry deposited in the Fraser has not much exceeded 6,000,000 annually at the most, being generally less, with a high percentage of survival it is possible that an impression has been made. Not only were the conditions improved in the poor years of 1895 and 1896 by some cause, if not by this one, but the effects were also felt in the years of greater anticipation which immediately preceded and followed them, though the greatly reduced catch of 1898, which should have been a good year, is to be noted in this connection. The present inspector of fisheries accredits these results to the combined influence of the hatchery and of better protection in the upper waters, where the Indian methods of barring the passage of spawning fish have been suppressed wherever possible. He also claims the recent establishment in Morris Creek, where the hatchery supplies have been obtained and where much of the fry has been deposited, of a type of sockeye which spawns later than any of the runs observed during the earlier operations in that locality, and these he supposes to be the product of artificial propagation. These late spawners are in great abundance every year, even when there is a scarcity at other breeding-grounds. The observations of Mr. McNab in regard to this matter are of much interest, and if the facts are substantially as he states them it raises again the old question as to whether salmon always return to precisely the same ground where they were hatched and make their run at the same relative time of the season as the parent stock from which they were derived. There are no data at hand for reaching a conclusion in this matter, with respect especially to such a complicated system as is presented by the Fraser River, but should the proposition so often raised be the true one, then the hatching work on this river would be productive only of late-running fish, those from which the eggs have been taken. These late runs probably occur, in part at least, after the close season has begun, and are of little or no benefit to the fishermen, but until the subject is better understood we are perfectly justified in giving the experiment the benefit of the doubt, and in regarding with favor the work accomplished.

MORTALITY AFTER SPAWNING.

During our inquiries of 1895 no new positive information was obtained regarding the extent to which the sockeye return to the ocean after accomplishing the object of their journey into the fresh waters. The testimony secured on this subject did, however, emphasize the fact that the mortality after spawning is very great, and is shared by all the species of *Oncorhynchus*. The waters about and directly below the numerous spawning-grounds become charged with great numbers of dead salmon, whose decaying bodies fill the air with the odors of putrefaction, but, while the stench becomes almost unbearable, no widespread pollution of the Fraser or Skagit rivers seems to result from this cause. Detailed observations to determine the proportion of deaths are wholly lacking. Those who have observed the conditions are not in accord in their deductions, though all agree in placing the death rate very high, especially as regards the humpback, dog, and silver salmon, as well as the sockeye. Some feel confident that of these species none survive, while others are equally certain that only a part meet death.

The only serious attempt at a solution of this problem in British Columbia was made by the late Thomas Mowat, whose experiments, however, were cut short by his unfortunately early death. The most complete account of his observations and deductions that we have seen are contained in an unpublished letter written in 1890, from which the following is an extract:

> I have much pleasure in informing you that I have proof without doubt that the *Oncorhynchus* or Pacific salmon do in many cases return to fresh water annually for the purpose of reproducing their species. I have proof of this in the case of the quinnat (*O. tschawytscha*) and sockeye (*O. nerka*), and I am confident from observations I have made that the coho (*O. kisutch*) do return in larger numbers than those first mentioned.
>
> During the seasons of 1884, 1885, and 1886, I made use of a leather or harness-maker's punch to mark the quinnat salmon after they had been partially stripped of their eggs and were obliged to be returned to the pens. The marking was done by punching one or more holes through the adipose dorsal fin, then passing a piece of colored cotton cloth or twine through the hole, so as to distinguish them from the fish that had not been handled. Sometimes we cut a portion or the whole of this fin off, and those fish were returned to the water after we had finished stripping them. Two successive years later a few of the fish so marked passed through our hands and were recognized, and I learned that some had been taken by the netters. It must be understood that the strings were not left on the fish. The fin was found to be withered somewhat, with the hole partially grown up. Since the season of 1887 we have been operating on the sockeye, and, as I have already described, some of these were marked in a similar way, but owing to having so many in the pens we had to keep different marks on them, so that the tails of some were bent or doubled up, a piece being taken out. Two of the fish marked in this manner were taken by netters this season and sent to me.
>
> My contention has always been that at least four species of our salmon return to the rivers to reproduce. The fourth, including those alluded to, is the steelhead, of which none die except by accident. My opinion is that 75 per cent of the quinnat salmon survive that ascend from 75 to 100 miles inland; those that ascend from 100 to 1,000 miles, or reach the summit of the Rocky Mountains, are reduced from various causes down to from 5 to 25 per cent. The percentage of the sockeye that survive are slightly under the quinnat, while those of the cohoes are over, as they do not ascend so far inland and have a better chance of returning. The qualla and humpbacks die in larger numbers, as they are more pugnacious, spawn in shallow water, and are more liable to disease. I quite agree with you as to the views

> held in reference to the salmon returning. They no doubt descend very rapidly, and either in the deep water of the center of the streams or along the shores, where they are less apt to come in contact with nets. I have on several occasions noticed the spent sockeye salmon swimming down this river toward the gulf, and I have been informed by the netters that they have taken them; but of course there is not the same chance of capturing them on their return to the ocean.

Observations made elsewhere in Pacific coast rivers do not confirm Mr. Mowat's conclusions regarding the sockeye. Dr. T. H. Bean, who made a study of the Karluk River, at Kadiak, Alaska, in 1889, expresses the opinion that no spawning sockeye leave that river alive, although they may live in the lakes at its source during more or less of the winter.

Prof. B. W. Evermann, who has given much attention to the salmon question in the headwaters of the Columbia River in Idaho, and whose statements are based on most painstaking observations, says of the sockeye in that region:

> What becomes of the redfish after spawning? Our observations, made at Alturas and Payette lakes in 1894 and 1895, and particularly those at Alturas Lake in 1895, which have already been given with considerable detail, leave no doubt as to the answer to this question. The redfish which spawn in the inlets to the Idaho lakes never return to the sea, but all die at the close of the spawning season. The evidence is conclusive.

Had Mr. Mowat been spared to continue his inquiries during a longer period, it is to be expected that he would have succeeded in throwing much light upon this still perplexing question. In the face of the other evidence just cited, it can scarcely be admitted that his deductions are conclusive as regards the sockeye. While Professor Evermann's observations relate to waters at a long distance from the sea, the Karluk spawning-grounds are much nearer to the ocean than any in the lower tributaries of the Fraser River.

An argument may be based upon the uniformity in size of the fish, but not safely without support from other evidence. Thus the sockeye, silver salmon, and humpbacks each run quite uniform in weight, the majority of those which enter any river averaging about the same. Did they make repeated ascents, the older fish might be expected to attain successively larger sizes, but as the sizes vary little, it is natural to assume that, with possibly few exceptions, they make but the one journey—are adapted to spawn but once. That a few escape might explain the occasional capture of larger sizes, as reported from time to time. The quinnat and dog salmon, on the contrary, exhibit a considerable variation in size, suggesting the survival of a greater proportion of the fish after each spawning, a greater power of longevity, and the opportunity of making two or more runs. Notwithstanding this argument, however, the dog salmon have been counted among those which die most readily after spawning.

From a practical standpoint the question of mortality may be assumed as having some importance for consideration in connection with regulations for the protection of the salmon. If all the individuals of a species composing a season's run die at their spawning-grounds, why is it necessary to provide for the escape past the nets of the fishermen of more than are required to insure the perpetuation of that species by spawning? If, on the contrary, the mortality is small and the same fish ascend through two or more seasons, then those which escape capture one year may be regarded as saved for the benefit of the fishermen in succeeding years.

In either case, however, the distinctions to be drawn are very fine, and it is difficult to conceive of a regulation based upon such conditions in view of the uncertainty attending all fisheries, and especially one whose operations are so extensive and whose resources are still so untried as the salmon fishery of this region. A sufficient quantity of salmon should be permitted to pass the nets to insure with absolute certainty the maintenance of the supply. The proper number for that purpose can never be accurately determined, but prudence demands a very large margin.

QUINNAT SALMON.

The quinnat, *Oncorhynchus tschawytscha* (Walbaum), known also in this region as the tyee and spring salmon, is recognized here, as elsewhere, as the finest in quality of the Pacific group of salmon, its flesh excelling that of all the other species in richness and delicacy of flavor. It is not, however, nearly so important commercially as the blueback or sockeye salmon, being much less favorably regarded for canning purposes, mainly on account of the lighter color of its meat. Still, for other uses, and especially for the fresh trade, it is most highly prized, and, excepting the peculiar white-meated individuals hereafter to be described, there is demand for all that can be taken.

While with this as with the other species, it has been necessary to depend chiefly upon the market fishermen and sportsmen for a knowledge of its movements, enough has been learned to establish several points of interest and to indicate that this region offers an exceptional opportunity for rounding out the life history of this conspicuous member of the salmon tribe.

The quinnat differs markedly in its habits from the sockeye, and is apparently always present in the Gulf of Georgia and in Puget Sound, where it may be captured at practically all times of the year. This fact would seem to indicate that the inner salt waters of the region furnish conditions suited to its welfare during all seasons, although, of course, its entry into fresh water is essential for spawning purposes, and it is to be presumed that a certain proportion finds its way to the ocean every year.

During the winter months good hook-and-line fishing is obtained in several places, and probably would be found in many others were trials made, but operations of this character are as yet restricted both as to locality and number of men employed, the Indians being the principal participants. The quinnat do not apparently then congregate together in as large or compact bodies as during the period when their movements toward the rivers are taking place. They are more scattered and seemingly remain more constantly, if not always, below the surface, and to some extent at least in comparatively deep water. It is accordingly impossible to judge of the general abundance of the species in the inner salt waters at that season, or of the proportion which may seek winter quarters in the open sea, if any do. They are observed and may be taken at different places through the Strait of Juan de Fuca, but it could not be learned that they move through this passageway in such defined schools as are characteristic of the other species. Should they do so, however, they may swim too low to fall under the observation of the fishermen. From all the data that have been collected it seems not improbable that the species, in general, never goes far from land, this view being strengthened by the fact that the river runs begin very early in the year.

In the stomachs of individuals captured in the Gulf and Sound, shrimps, herring, and other small pelagic fishes have very commonly been observed, showing positively, if such proof were needed, that they avail themselves of the opportunities for feeding afforded by the inner waters, as good undoubtedly as could be found upon the outer coast. It is this circumstance which leads to their taking bait and makes them the object of a hook-and-line fishery, both for market and for sport. Whether they continue feeding in the salt water during the spring and summer was not learned. They are said to refuse both food and bait during their passage up the Fraser River, which is in accordance with the general understanding of their fresh-water habit, but exceptions to this rule seem to have been quite clearly demonstrated in the case of certain small rivers which will be referred to again.

The line fishing or trolling is carried on mainly during November, December, January, and February, by both Indians and whites. The principal localities brought to our attention were off Nanaimo, Howes Sound; off the estuary of the Fraser River; off Victoria, Becher Bay, among the San Juan Islands; off Port Townsend, off Port Gamble, and in Hoods Canal. One of our informants had often fished successfully for the quinnat during these months at Nanaimo within 10 yards of the wharves, using spoon bait. The fish occurring there would disappear in February, beginning then to make their way up the rivers. Another informant described the general fishery off Nanaimo as deep-water trolling with herring bait and spoon, which continues until into March or April, after which the fish become scarce. At Victoria winter fishing is carried on to a distance of 8 or 10 miles from shore, chiefly from December to February, inclusive, the Indians going out whenever the weather is suitable. Supplies are also received at Victoria from Becher Bay. Some fishing is done at Port Townsend close by the wharves and farther off shore, but the fish do not seem to be as abundant there as in other places. The San Juan Islands afford good winter grounds, and quinnat are also taken among those islands in April and May.

The quinnat commence schooling and running as early as February. On the upper part of the Washington coast the first run occurs in that month, the fish following the herring north around Point Roberts. A second run is said to begin the latter part of April and to continue during May and June, small numbers also passing Point Roberts during the remainder of the summer, when they may be taken in the traps set for the sockeye. The fall run starts in the latter part of September and ends some time in October. Among the San Juan Islands the movements were described as practically the same.

This species seems to enter many, if not most, of the rivers of this region, the abundance in each being measured by the size of the stream. A few, it is said, may be found in the lower 40 miles of the Fraser River during the entire winter, but nothing is known of their habits there at that time. Scattered individuals begin to enter and ascend the river in February, and in some years, it is claimed, as early as January, dependent upon the openness of the winter, but the species remains scarce until in April. Some fishing may be done the last of March, but not until the river becomes somewhat discolored by the spring freshets are the conditions favorable for the extensive use of drift nets. The main part of the spring run occurs in May and June, being heaviest in the latter month, when the best fishing may be had. As July comes on the supply drops off, and during that month and August only a few are obtained, in conjunction with the sockeye. The fall run, commencing generally in the latter part of September and continuing into October, while of some importance, is much inferior to the spring run.

The quinnat apparently distribute themselves quite generally throughout the Fraser River system, and ascend the different branches as far as conditions permit. The earlier or spring runs travel farthest upstream, the fall fish, it is said, spawning in lower tributaries, one of which is Pitt River, only about 50 miles above New Westminster, and another, Harrison River, somewhat higher up. The spawning season, according to Canadian authorities, is mainly in the latter part of September and during October.

The artificial propagation of the species was taken up on the Fraser River in 1884, at the same time as the sockeye, but was discontinued after five years' trial. It had been the original intention to obtain at least a portion of the spawn from the Columbia River, with the object of attempting to increase the proportion of fish with more deeply colored flesh, but this part of the plan was never carried out, operations being entirely confined to the local run. The parent fish were caught with dip nets at night in swift water on the Harrison River rapids, where they lay, and were held in cribs awaiting stripping. According to Mr. Mowat, the species is hard to strip, and in some cases it is necessary to handle the fish two or three times to obtain all their spawn. The eggs are large and vary a great deal in color. Their number is small in comparison with the *Salmo salar*, averaging only about 4,000 to each fish, and the period of incubation is very much shorter, this being accounted for by the temperature of the water, which is higher in the Fraser River during the winter than in the salmon rivers of the Atlantic coast. Parr kept to the age of seven months attained a length of 3 to 4 inches. The total number of fry planted during the five years was only about 6,000,000, an amount quite insufficient to have any appreciable effect toward increasing the supply.*

Very little information was obtained regarding the runs in other rivers than the Fraser, as not much fishing is done in any of them, but the seasons are essentially the same in all, so far as could be learned. We were told, by a close observer acquainted with the region, that in the Cowichan and Nanaimo rivers of southeastern Vancouver Island they begin running about the time the snow freshet commences in February. During the early part of the season they ascend leisurely, stopping in the pools, where good sport fishing may be had, and finally reaching the lakes at the head of both rivers, where they remain until the spawning time. Later runs occur up to and including the early fall. In Washington the Skagit River furnishes the largest catches which reach the Seattle market, but they are regularly fished for on several other rivers.

Eighteen pounds is given as a fair average size for the quinnat on the Fraser River, but in the Seattle market the average was placed between 20 and 25 pounds. In the market catch they range down to about 10 pounds, and individuals weighing 40 to 50 pounds are taken to some extent. The extreme sizes brought to our notice were 60, 70, and 80 pounds, but these are rare.

Notwithstanding the generally high esteem in which the quinnat salmon is held, it exhibits in this region a remarkable peculiarity, only exceptionally occurring elsewhere, which seriously affects its sale. While in some of the fish the flesh has its ordinary deep pink color, in others the flesh is white, or only slightly tinged with pink. All intermediate gradations of coloration, as well as intermixtures of the two, occur, and no degree of this variation is distinguishable from the outside. One end of the fish may be pink and the other white or the two sides may differ in this respect. White stripes may extend through the pink meat, or the reverse, and spots of one color may be disseminated through a mass of the other. In the paler fish the color may greatly fade or disappear entirely during the process of cooking, salting, or canning. In a letter transmitting specimens to Washington for examination, in 1887, Mr. Mowat describes the conditions as follows:

> I find that some of the run are pure white; some are very pale pink; some a little darker, and others of a fair color, like the samples sent. I also find that some are white on the outside near the skin for about 1 inch in depth, then gradually turn a pale pink, deepening in color as the bone is reached. A few fish of this description

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* Since the above was written information has been received regarding a private hatchery built on Samish Lake, near Fairhaven, Wash., in the fall of 1898, in which about 200,000 quinnat eggs from the Columbia River were at once placed, and also about 100,000 eggs of the silver salmon from local sources. An effort is being made to have the State assume the expense of running this hatchery and to have its capacity enlarged.

are found among the July run, but the majority of the quinnat salmon running now are white or pale pink. Fish wanting in color are not canned, as cooking will draw the balance of the coloring from them. On examining a number of these fish a few days ago, I found some of them with a slight tinge of pink around the bone and that the majority of them would spawn within a month. The ova, like the fish, also varied in color; but the lighter they were, the larger and nearer to maturity. The same particularities as to color occur in eggs taken from the fish on the spawning-grounds.

The lighter or off-colored fish are said to be found at all times, but their proportionate number may vary more or less at different seasons. Thus, for instance, on the Fraser River the white-meated fish are reported generally to form only a small percentage of the spring catch, though their number may increase toward the end of the spring run. Beginning in August or by September 1, however, the number becomes very large, and before the season closes may reach as high as 60 to 90 per cent. In Puget Sound and the more southern rivers, on the contrary, it is claimed that the percentage remains more nearly uniform throughout the fishing season, although the average color may turn a little lighter as the season advances, and that the percentage of the white-meated fish is not so large as at the north. That so marked a difference as is described should be manifested in a region of such limited extent is striking if true, but it is not at all improbable that the statements are somewhat at fault. There is no doubt, however, that a very large number of the light-colored fish are taken. Epicures claim that their meat is as rich and as well flavored as though it possessed the deeper color, but by people generally the salmon are graded according to color, whether fresh, canned, or salted, and a prejudice exists against any which have not the prescribed shade. There is, therefore, scarcely any sale for the paler fish. When placed upon the market fresh they command a very inferior price, while canned or salted they rarely find a purchaser. It is hoped that this prejudice will soon be overcome, permitting what is now essentially a waste product to be utilized in accordance with its true value.

Leaving the question of color out of consideration, the quinnat are said to be always in good condition when taken in the salt water, the winter catch being the best. During their movements up the river they are also in prime condition in the spring, but as the summer advances, especially by August, they show considerable deterioration, which increases as the spawning season approaches, until finally they practically cease to have any market value.

The quinnat taken in this region are most highly valued for the fresh market. There is, in comparison with the extent of population, a relatively large local sale, and in the spring a considerable export trade to the Eastern cities of the United States. The latter begins at an early date and continues on rather an extensive scale until about the 1st of June, by which time generally the season for the Atlantic salmon has fairly opened and the demand comes practically to an end. It may, however, still be shipped for a time in small quantities to inland points as far east as Chicago. The spring trade is said to be constantly increasing, and in a frozen condition the species is now being sent to foreign countries. A considerable quantity is also salted for export, and after the heavier shipments to the East have ceased, and the high price then prevailing has fallen in consequence, they may be put up by a few of the canneries, especially on the Fraser River. By the time the canneries are in full operation, however, the quinnat have become scarce, and in the fall their quality has depreciated, while the inconvenience occasioned by the number of light-meated fish in the catch causes many of the canners to avoid handling them even at a season when their condition might otherwise be favorable. The canned quinnat of good color is graded about with the sockeye, the deeper and more stable tint of the latter increasing its relative value as compared with the quinnat, despite the inferior quality of its flesh.

On the Fraser River commercial fishing for the quinnat is restricted to the use of drift nets. On the Washington coast the species is obtained only to a limited extent in traps, which are seldom set until after the principal runs are over, and the catch therefore consists mainly of scattered individuals taken in conjunction with the sockeye. No dependence is placed upon the species at Point Roberts, and it has not been the practice to fish for it specially at that place. Nets are used for its capture in some of the rivers of Washington. Its game quality has led to a considerable fishery in the salt water with hooks and lines, which is carried on mainly for profit, but also to a slight extent for sport. The fishermen are chiefly Indians, and the season is principally the winter, beginning in November. The method followed is trolling with both bait and spoon at various depths below the surface, dependent on the position of the fish. Herring is the bait usually employed. The principal localities of this fishery have already been enumerated. While no statistics on the subject are obtainable, the catch by this means is probably very inferior to that made by nets in the various waters of British Columbia and Washington.

SILVER SALMON.

The silver salmon or coho, *Oncorhynchus kisutch* (Walbaum), ranks next in importance after the sockeye and quinnat. It is considered the most handsome of the salmon tribe, and in the salt water has game qualities in common only with the quinnat. The color of the flesh, though much lighter than in the sockeye, is as deep as in the quinnat, but it fades to such an extent in cooking as to make the species less desirable for canning than either of the former. The flesh is also drier or less oily, but of excellent quality for the table when fresh, and packs nicely. The Indians prefer this species to the sockeye for their own use, probably because it is more readily cured by their process of drying.

The size, as observed in these waters, is reported to range from 2½ to 10 and 12 pounds, but to run generally from about 6 to 8 pounds. The species is said to attain 30 pounds in Alaska.

There is some uncertainty regarding the length of stay of the coho in the salt waters of this region. From what appears to be good authority it was learned that individuals have occasionally been caught by trolling in the spring and early winter. It has a well-defined run, however, and occurs abundantly only during a limited season, lasting generally about six weeks. The date of its first appearance varies in different years, as well as in different places during any one year. The schools are expected to arrive between the middle of August and the first few days in September, being reported earliest at points along the Strait of Juan de Fuca, sometimes, it is said, before the middle of August.

In Puget Sound the earliest recorded catch for the Seattle cannery was made on August 28, 1889. In connection with the fishery in that locality no preparation is made for taking silver salmon before September 4, and no reliance is placed on the species after October 23, though large supplies have been obtained as late as October 28 in the vicinity of Everett, while in other localities the fishery has continued until November 1. A few may even be taken as late as between the middle of November and 1st of December, after which they are rarely seen.

In the Fraser River, while the coho may begin ascending even before the sockeye season has fairly closed, they are not expected to run abundantly until about September 10. Their movement continues through most or all of October, but the duration of the main run is said to be only from four to six weeks. The date of running in the other rivers is probably about the same. A few may appear in the Washington rivers as early as August 15 to 20, but they do not become abundant until some time later, and may continue ascending until the last of October.

The silver salmon become widely disseminated through Puget Sound and the Gulf of Georgia, and enter many of the narrower channels among the islands, in which respect they differ from the sockeye. They ascend the smaller as well as the larger streams of the region, but in the Fraser River they apparently do not proceed very far above the sea. Much of their spawning-ground is just beyond the influence of the brackish water, and for spawning purposes they may enter even little creeks and rivulets in which the water seems scarcely deep enough to admit them.

Their spawning season, according to the testimony of Canadian experts, begins about the middle of October and continues until about January, but it is supposed to occur mainly during November. In 1885 a few thousand eggs were hatched artificially at the Canadian hatchery on the Fraser River, but no serious attempt has been made to increase the abundance of the species by this means.

The silver salmon are described as active rovers in the salt water, and their habit of leaping makes them readily distinguishable at the surface. They occur in large bodies and also thinly scattered over extensive areas, being erratic in their movements and often changing their position rapidly. Near the close of October, 1886, after the fishing season had apparently ended, schools were reported off the town of

Everett. Two purse seines were immediately put in operation, and in one haul it was estimated that fully 10,000 fish had been surrounded. The fishing was continued uninterruptedly during three days, the quantity assembled being the largest ever known, but on the fourth day they had entirely disappeared, and none were subsequently observed in this locality. This sudden disappearance from the salt water in the fall is said to be the rule, and those fishing for the species find their occupation abruptly terminated. The last of the large bodies must therefore make a quick move toward the rivers and their spawning-grounds. The important fishing-grounds in Puget Sound extend mainly from the vicinity of Everett to Tacoma.

There is a considerable variation in the general abundance of the species from year to year, and also as regards different parts of the region. Thus, while they may be scarce in some localities and exceedingly plentiful in others during any one year, the following year these conditions may be more or less reversed, and this applies to the rivers as well as to the salt waters.

There is a reported decrease in the quantity of this species observed in certain places, as in Semiahmoo Bay, Birch Bay, Bellingham Bay, Samish Bay, and Elliot Bay, but if such a decrease has actually taken place there is nothing to show that it is more than local in character. In Elliot Bay and some other places the fishermen claim that it is due to the amount of steamboating now going on. In the other bays above named the decrease has been charged against the continued heavy fishing by seines at the period when the coho are entering the rivers.

The silver salmon appears not to be canned on the Fraser River, except in the case of a shortage in the pack of sockeye. The same is also true in principle with regard to most of the Washington canneries, but in fact it has been so difficult to obtain sufficient supplies of sockeye at nearly all the latter that the silver salmon is extensively used in place of it, and it also composes an important part of the catch made for the Seattle cannery, where the sockeye is not put up. It is extensively salted on the Fraser River for the export trade, and is one of the favorite species with the Indians for their own use.

The traps at Point Roberts, Lummi Island, and the San Juan Islands are mostly removed before the run of silver salmon is fairly on, but some may be left in place for the special purpose of obtaining this species if the sockeye catch has been small, and it is also taken in the traps in Skagit Bay. The main supply from the salt water, however, has been obtained by means of purse seines, although drag seines and reef nets are also used, the former chiefly at the mouths of the rivers. On the Fraser River the fishery is by means of drift nets.

The silver salmon, like the quinnat, affords good sport fishing in the salt water, and may be taken by trolling, either with or without a spoon. This method is resorted to for commercial purposes in some localities, but the catch is small. It is also said that they may be taken in this way in the lower 2 or 3 miles of some of the small rivers.

THE HUMPBACK SALMON.

The humpback salmon or "haddo" of the Indians, *Oncorhynchus gorbuscha* (Walbaum), is a small species, averaging only about 4 or 4½ pounds in weight, although the male may reach as much as 6 pounds. From the sockeye, with which it is most commonly associated, it is readily distinguished by the shape of the body, the much finer scales, and the coarse spots on its tail. In the salt waters of this region it occurs chiefly during August, though appearing generally the latter part of July, and may continue present into the early part of September. Its season, therefore, practically corresponds with the last half of the sockeye run, and the two species are often obtained abundantly together in the trap nets, much to the annoyance of the fishermen, as the humpback is in little favor either for canning or other purposes. A peculiarity of the species is the fact that it makes its appearance only in alternate years, those indicated by odd figures, as 1895, when we had the opportunity of examining many specimens. If any are present in off years they are so few as to escape the notice of the fishermen.

During the years of their occurrence they are exceedingly abundant. They are said to move slowly, in large schools, rolling in the water somewhat after the fashion of the porpoise, with the dorsal fin showing at the surface. Dr. Bean says of them in Alaska that they are much addicted to jumping out of the water, one of the commonest sights in the vicinity of St. Paul, Kadiak, being the breaching of the humpback. In Puget Sound and the Gulf of Georgia this habit was ascribed only to the silver salmon. Although quite a vigorous fish, the humpbacks die quickly when taken in the nets.

In Puget Sound, where they are regularly fished for, the earliest catches are generally obtained during the first week of August, and fishing is expected to continue until the end of the month. Small numbers have occasionally been taken as early as July 24, and large hauls have been made as late as September 8. The season is probably approximately the same for all parts of the salt waters, except that they would be expected to appear somewhat earlier in the Strait of Juan de Fuca, and occasional small captures by the drift nets have been reported in the lower part of the Fraser River by July 20.

While the humpbacks enter at least most of the rivers and smaller streams of the region, they are said to avoid certain ones, but the testimony in this regard is not conclusive. They apparently do not ascend very far above the sea, although they may reach the headwaters of the shorter rivers, to which class, in fact, belong most of the rivers along this coast. They enter all of the lower tributaries of the Fraser River, from Burnaby Lake at New Westminster to Harrison and Chilliwhack rivers, and probably to a short distance farther up. They require but little water for spawning, and even resort for that purpose to the narrowest and shallowest creeks, sometimes not over a few feet wide, and a foot and a half deep. In their spawning-places they congregate in such exceeding abundance that they are described as forming at times almost a solid mass, from which the stench produced by the dying fish is said to be intolerable. The spawning season on the Fraser River is reported to be from the latter part of September to the middle of October, and the occasional association of the humpback with the sockeye on the same grounds during this period has given trouble in securing the eggs of the latter for the Canadian hatchery.

The flesh of the humpback is of a very light pinkish color and much softer than in the sockeye and quinnat, for which reasons the species is not highly regarded for canning, and has been regularly used for that purpose only at Seattle. The fish deteriorate rapidly, especially when caught in large quantities and heaped in scows from the traps or seines. Those in the lower layers, especially, soon become damaged and misshapen and lose their scales, greatly detracting from their appearance. Nevertheless, the humpbacks are considered by many as having excellent food qualities when taken in the salt water, particularly during the early part of the run. In some of the local markets they are sold fresh in small quantities. On the Fraser they are salted and smoked for export to China and other countries demanding a cheaper grade of salmon, and many are taken and prepared by the Indians for their own use, both in the fresh and salt waters.

The output of the cannery at Seattle consists largely of the humpback, which, selling at a low price, finds a ready sale in the southern part of the United States. The supplies for this cannery are obtained mainly in the salt waters near and to the north of Seattle, by means of drag seines hauled on the beaches. Small quantities are also brought from some of the rivers. In the season of 1891, four seines operating for this cannery made a total catch of 275,000 fish, but this represents only a part of the fishery that was in progress that year.

The local demands in other places along the shores are also chiefly supplied through the agency of drag seines, while on the Fraser River the commercial fishery is by means of drift nets. The trap nets would appear, however, to afford the best means for the capture of the humpback in the salt water, and they are sometimes so taken in immense quantities during the sockeye run. In fact, they often compose by far the larger part of the catch, and as it is generally impracticable to do the sorting in the water at the net, the entire catch may be emptied into scows and the overhauling take place at the wharves. Here the humpbacks are culled out and discarded, causing a wholesale destruction of the species. There seems to be no immediate solution of the problem as to how this loss might be prevented, but the question calls for serious consideration, as incalculable harm may be done the supply of humpback in the course of a few years, by which time its market value is certain to be much increased.

DOG SALMON.

The dog salmon, *Oncorhynchus keta* (Walbaum), comes next after the quinnat in size, but differs greatly from that species both in habits and in the quality of its flesh, while its peculiar color markings readily distinguish it from all other forms. On the Fraser River it is said to weigh mainly from 12 to 15 pounds, although many are taken up to 25 pounds, and individuals have been caught weighing 40 pounds and over.

Very little has been learned regarding its movements. A few may occasionally be secured as early as the middle of August among the other salmon. The regular run, however, is stated to begin in September and to continue through October and more or less of November, sometimes not ending until about December 1. In the purse-seine fishery tributary to Seattle the first catches during the six years from 1889 to 1894 varied in date from September 10 to October 17, and the last from October 27 to November 17. These figures, however, can not be assumed to indicate at all positively the duration of the run in any of those years without other information, as in some seasons the fishery may have been started late or may have terminated before the run had ceased. In January, 1897, dog salmon were reported present in the salt water, being then in good condition and having the appearance of just coming in from the ocean.

This species, like the humpback and silver salmon, seems generally not to ascend the rivers far above the sea, but it enters all streams, large and small, going even into the little creeks for spawning. Its distribution in the Fraser is limited to the lower tributaries, but while it is there considered one of the least abundant species, in some of the smaller rivers elsewhere it appears in relatively very large numbers, the fish crowding together in narrow and shallow places, which become badly polluted by their dead and decaying bodies. According to Mr. A. B. Alexander, in the fall and winter all the small creeks, lagoons, and sloughs near the Dwamish and Cedar rivers, Washington, are filled with dog salmon, and boys find great amusement in killing them with clubs and stones. In the rivulets by the roadside, where the water is not over 2 or 3 inches deep, dog salmon may be seen trying to get farther upstream. Mr. Mowat says that they spawn principally in quiet creeks and in the shallow waters along the river banks, even doing so in water so shallow as to leave part of the back exposed.

The dog salmon are not generally held in good repute, although when taken in the salt water, especially soon after coming in from the ocean, their flesh is firm and they are handled to some extent in the fresh markets of Washington. They are regularly canned at Seattle, and small quantities have been put up at one or more of the other Washington canneries, the supplies for this purpose being obtained in Puget Sound by means of purse seines. The color of the flesh, which is always light, is said to grow paler as the season advances. The fish deteriorate rapidly after entering fresh water, and the jaws in the males become very much hooked. The Indians on the Fraser River and elsewhere make use of the species to some extent, more particularly when the other salmon are scarce.

STEELHEAD.

This large trout, the *Salmo gairdneri* of Richardson, is commonly classed as one of the salmon by the fishermen of this region, and is customarily sold as such. In different localities its average weight was placed at from 8 to 15 pounds, while extreme sizes reach 25 and more pounds. The excellent quality of its flesh causes it to be highly prized for the fresh market, but the color is too pale to suit the requirements for canning, although it is said that small quantities have at times been prepared in that way. It does not seem to be as plentiful as any of the species of true salmon, or at least does not congregate in such defined schools in the salt water, and in other respects its habits are evidently also quite different. It appears to ascend the rivers in small numbers during an extended period, but the main run begins in November and continues through more or less of the winter. The species is not captured abundantly at sea unless it be in a few places, the principal fisheries being carried on in the rivers and lakes during January, February, and March, when the fish are in excellent condition, but they subsequently deteriorate and are not in favor in the spring.

The steelhead will take the fly in the fresh water where it is clear, and are looked upon by the fishermen as especially ravenous feeders, not deserving of protection in a region where their presence is considered harmful to the young salmon of other species, especially the quinnat and sockeye, on whose spawning-grounds in the Fraser River they are reported to have been observed. The Canadian regulations, however, have greatly restricted their capture at the season when they could best be taken. The spawning season is said to be in the early spring, and possibly begins in the latter part of winter.

There is a sale for all the steelhead that are caught in the winter, and they are especially in demand for shipping fresh to the eastern and inland markets. This is largely owing to the firmness of the flesh, which permits them to be kept longer in storage in good condition than any other species, but as regards the quality of the flesh they do not occupy the first place. The total annual catch, however, has been relatively small compared with that of most of the other salmon. The fresh-water fishing-grounds are widely distributed, Sumas Lake being one of the most important in the Fraser basin. In Washington the principal fisheries are on the Skagit River, but in nearly all other rivers of any size the species seems to be taken in greater or less quantities.

According to the report of the State fish commissioner of Washington for 1898, this species has been the mainstay of a large portion of the Washington fishermen during the winter months, and the fishery has been fairly lucrative. The run, however, had on the whole greatly diminished, and the output for the present season, from the best information possible, is not 50 per cent of what it was two or three years ago.

SALMON FISHING.

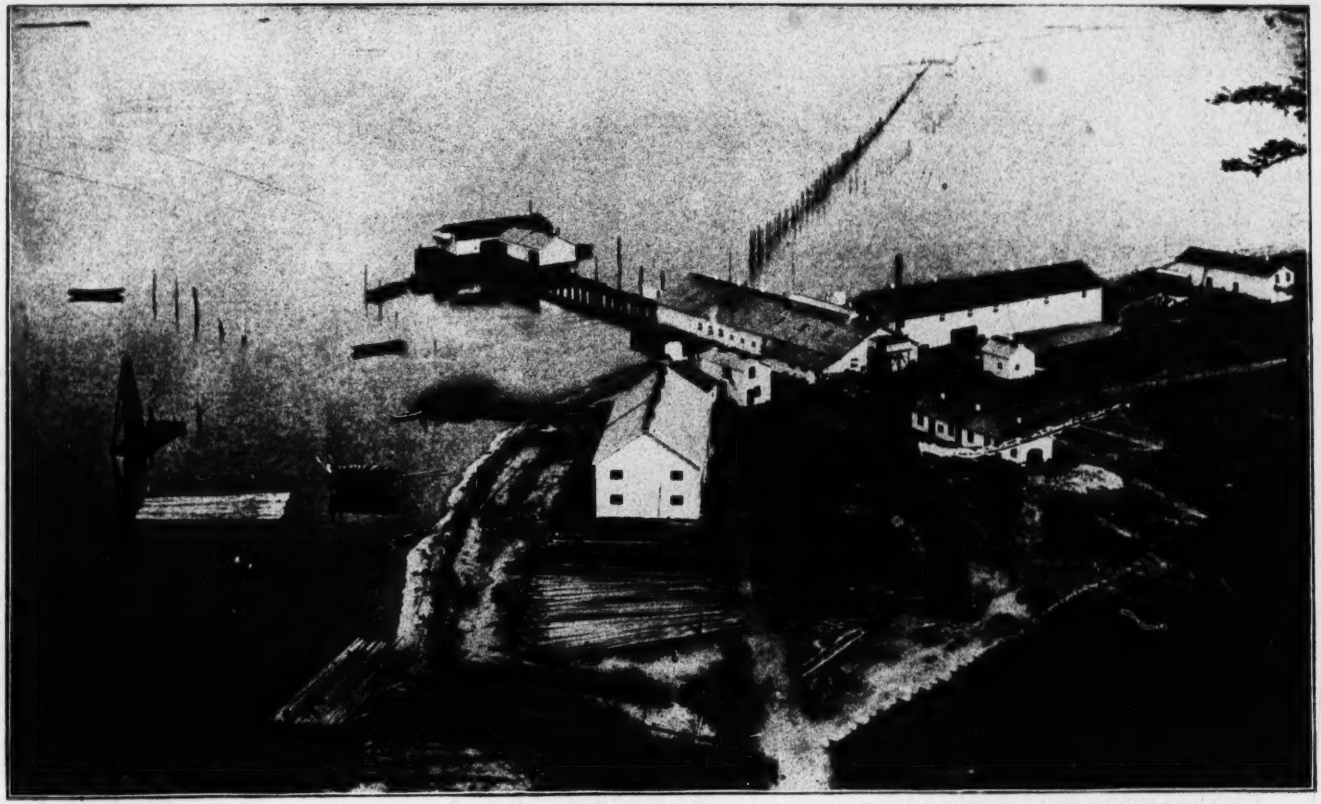
The Indians were fishing in this region when it was first invaded by the whites. They were then, however, solely concerned in supplying their own domestic wants, using apparently the same appliances they do to-day, reef nets and hooks and lines in the salt water, and spears, dip nets, and weirs in the rivers. Traders reached the upper Fraser very early in the century, thence working to the sea, and the salmon became one of their most important foods, being obtained partly by their own efforts and partly of the Indians. The latter gradually developed into commercial fishermen, and to-day constitute a prominent element in the fishing fraternity.

The white man's fishing seems to have been first definitely organized in British Columbian waters, as exemplified by the Fraser River, where its growth has been most rapid and systematic, and where its extent is probably still the greatest. Under Government supervision its methods there have practically been restricted to the use of a single form of apparatus, the drift net, which is especially adapted to the conditions prevailing where fishing is most actively carried on, and which also provides that the industry may be shared by the greatest number of individuals.

There is less definite information regarding the history of this subject south of the boundary line, although the whites possibly began fishing in the salt waters, where their catches have chiefly been made, some time during the sixties. Their methods have become much more diversified than in British Columbia, but it is only within about a decade that their industry has attained prominence. Their output seems destined very soon, however, to outstrip the Canadian fishery in amount and value, if it has not already done so at the time of writing. Fishing on a greater or less scale is carried on throughout most of the salt waters of Washington, but extensive operations are mainly concentrated in a few localities, as about Point Roberts, in Skagit Bay, and in the upper part of Puget Sound. Trap nets have become the most important means of capture. Before their introduction purse and drag seines and gill nets were the principal appliances and they are still used. There is some hook-and-line fishing, and reef nets continue to be employed by a considerable number of Indians.

In the Strait of Juan de Fuca there is comparatively little fishing for salmon. Small quantities are taken about Becher Bay, on the Vancouver Island side, chiefly by Indians, who also fish at the outer entrance of the strait, off Cape Flattery and Neah Bay, where one or more species are said to be sometimes quite abundant. On the south shore fishing in a small way, mainly for the fresh market and local use, has been carried on for some years, seines, gill nets, and hooks and lines being used. It is engaged in by both whites and Indians, who operate at several places along the coast, and also to a slight extent in the Elwha and Dungeness rivers. The sockeye is not known

PLATE 10.



CANNERY POINT, POINT ROBERTS, WASHINGTON, 1895, SHOWING THE CANNERY ESTABLISHMENT AND THE STRING OF THREE TRAP NETS EXTENDING OFF FROM THE POINT.

to appear on this shore, but all the other species are reported to be taken.

Point Roberts has figured most conspicuously in the Washington fishery, and the largest catches have been made in its vicinity. The principal reef-net ground of the entire region lies directly off its southeast corner, a large kelp-covered ledge, to which the Indians have undoubtedly resorted for many generations, and which has always been the cause of much contention among the several neighboring tribes. The perpetual right to fish upon it, in common with other inhabitants of the territory, was secured to the Indians by treaty with the United States in 1855, and while formerly regarded solely in the light of a rich collecting-ground, where their own needs could readily be met, it afterwards became the source of much revenue in their dealings with the whites. So far as the records show, the Indians have at no time resided permanently on Point Roberts. It has been their custom to be present there only during the fishing season, chiefly of the sockeye salmon, from about July 1 until early in September. In recent years their number has varied from 150 to 200, though sometimes reaching 250. Their canoes in active operation have been as many as 15 to 20, but lately the number has greatly fallen off through the intervention of the whites. Their drying racks formerly covered a considerable area, but they are now small in extent and have been entirely driven from Cannery Point, their principal location in more prosperous days. After the completion in 1894 of the continuous line of traps commanding the approaches to the big reef, its value for reef-net fishing seems to have been in great part destroyed, and the Indian catches declined so much in consequence as to render the old-time occupation practically unprofitable. The primitive methods are making way for those of civilization, and the process has not been wholly devoid of certain elements of injustice, which are by no means peculiar to this locality.

While the visits of the Indians to Point Roberts have had reference mainly to the salmon, they were at one time in the habit of going there in March, during some years but not continuously, in search of dogfish, of which they are said to have secured large catches. Those who went at that time might remain until the salmon season opened. They made use of a rude sort of gill net set along the flats, in which the dogfish became entangled, and also of trot lines having perhaps from 150 to 200 hooks apiece.

The Indians have also taken sturgeon in Boundary Bay, have fished there with hook and line in the fall for the silver salmon, and have used, by drying, the large clams which are very abundant along its shores.

There are no authentic records of the earlier fishing by the whites about Point Roberts, though it is well known that they were attracted there many years ago by the abundance of the salmon. In the beginning, however, it is probable that their supplies were chiefly obtained by purchase from the Indians. During the period when the Hudson Bay Company was active on the west coast, agents of the company made annual visits to the Point for the purpose of adding to their stock of salmon. In the early sixties, according to one informant, who has had a long experience in the region, several men were engaged in fishing and purchasing at the Point in a small way. There was, however, little expansion in the work for over a decade, and practically not until about 1875, when parties from Seattle went there to engage more regularly in the business, which then consisted chiefly in salting and barreling fish. The canneries on the Fraser River also began to obtain some of their supplies from this locality, but apparently never in large quantities.

The Indians furnished a part of the salmon; the remainder were taken in drag seines measuring about 100 fathoms long by 35 feet deep and with a 4-inch mesh. From 4 to 6 of these seines were in use from about 1875. The seining-grounds were on the west side of Point Roberts, extending northward from the southwest corner a distance of about 1½ miles, where the shore is free from stones and well adapted to the purpose. These nets were operated during the sockeye season, and later for the silver salmon, which species was taken in the greater abundance. Humpback salmon could be secured in large numbers, but they had no sale and were only used by the Indians. The quinnat were never fished for, as they ran too early in the year, when the weather was still stormy. Purse seines have also been employed about Point Roberts for some years, and are still used there to some extent.

There are no figures showing the catch during this period, but it is said to have fluctuated greatly, dependent upon the abundance of the fish and the number of men at work, the latter having varied from year to year. Between 1875 and 1889, according to the accounts received, the maximum number of whites present in any season was about 30. In some of those years the output would not have exceeded 450 barrels of salted salmon, while in others it reached as many as 3,000 barrels. This was in addition to what might have been sent to the Fraser River.

Fishing on a greater or less scale is carried on in most of the Washington rivers which empty into Puget Sound and the Gulf of Georgia. The Skagit is the principal of these rivers, and is especially noteworthy as the resort of the sockeye as well as of all of the other species of salmon. The runs are relatively large and excellent opportunities for fishing are thus afforded. Previous to 1893, however, most of the catch, such as it was, was disposed of locally to ranchmen, mill hands, and settlers, but in the year mentioned it is said that 300,000 pounds of salmon from this river were sold to the markets in Seattle. These were caught between Sedro and the mouth of the river, and consisted in large part of quinnat and steelheads. The number of fishermen was about 50, of whom perhaps one-half made this business their regular occupation. Above Sedro, including Baker River, the catch during the same year, reported to have been about 136,000 pounds, was still entirely utilized by the inhabitants of the neighboring country.

Nets were employed up to 1893 only in the main Skagit River. They were mostly gill nets of two kinds, one being set, the other drifting when in use. The same year two seines, 100 fathoms long and 30 feet deep, with a 3-inch mesh, were operated at La Conner at the mouth of the river, and in the same neighborhood the Indians had four seines of the same mesh, 30 fathoms long and 10 feet deep. A salmon wheel was also built in that year a few miles below Sedro, but the results were not satisfactory. Nearly all of the salmon taken in its two branches, the Baker and Cascade rivers, up to 1893 were obtained by means of spears and gaffs, both whites and Indians resorting to this method.

The recent rapid development of the salmon market at Seattle, the establishment of canneries at Anacortes, and the demands from canneries at more distant places have given a fresh impetus to the fishery in both the Skagit River and the bay of the same name into which it empties. In the latter especially has there been a marked increase in the amount of apparatus employed, which consists of trap nets, gill nets, and seines.

The Nooksack River is also, in proportion to its size, becoming of considerable importance as a salmon stream. The sockeye have been said to enter it, but the evidence to that effect is not conclusive. Fishing is carried on directly off the mouth of the river as well as at several places along its course. Gill nets have been chiefly employed, and it has been proposed to introduce trap nets near the mouth.

The salmon fishermen on both sides of the line are of many nationalities, most maritime nations of Europe being represented and also the Japanese. A large proportion consists of Indians and half-breeds, and some negroes are also employed. The Chinese, however, while they compose the bulk of the help in the canneries, have participated only to a very slight extent in the fishing and not at all in Canadian waters. Nearly if not quite all of the trap-netters are whites.

TRAP NETS.

The use of trap nets in this region has been restricted almost exclusively to the United States and mainly to the capture of the sockeye salmon in the clear salt waters, where no other kind of apparatus seems to be so well adapted for taking this species in the large quantities required by the canneries. With the few exceptions elsewhere noted, therefore, we find these nets distributed only along the course taken by the sockeye on their passage from the sea to their spawning rivers. They have not been tried in the Strait of Juan de Fuca, however, nor does it seem probable that the sockeye schools skirt the shores of that channel closely enough to give occasion for their employment at any place unless it be in the vicinity of Becher Bay, on Vancouver Island.

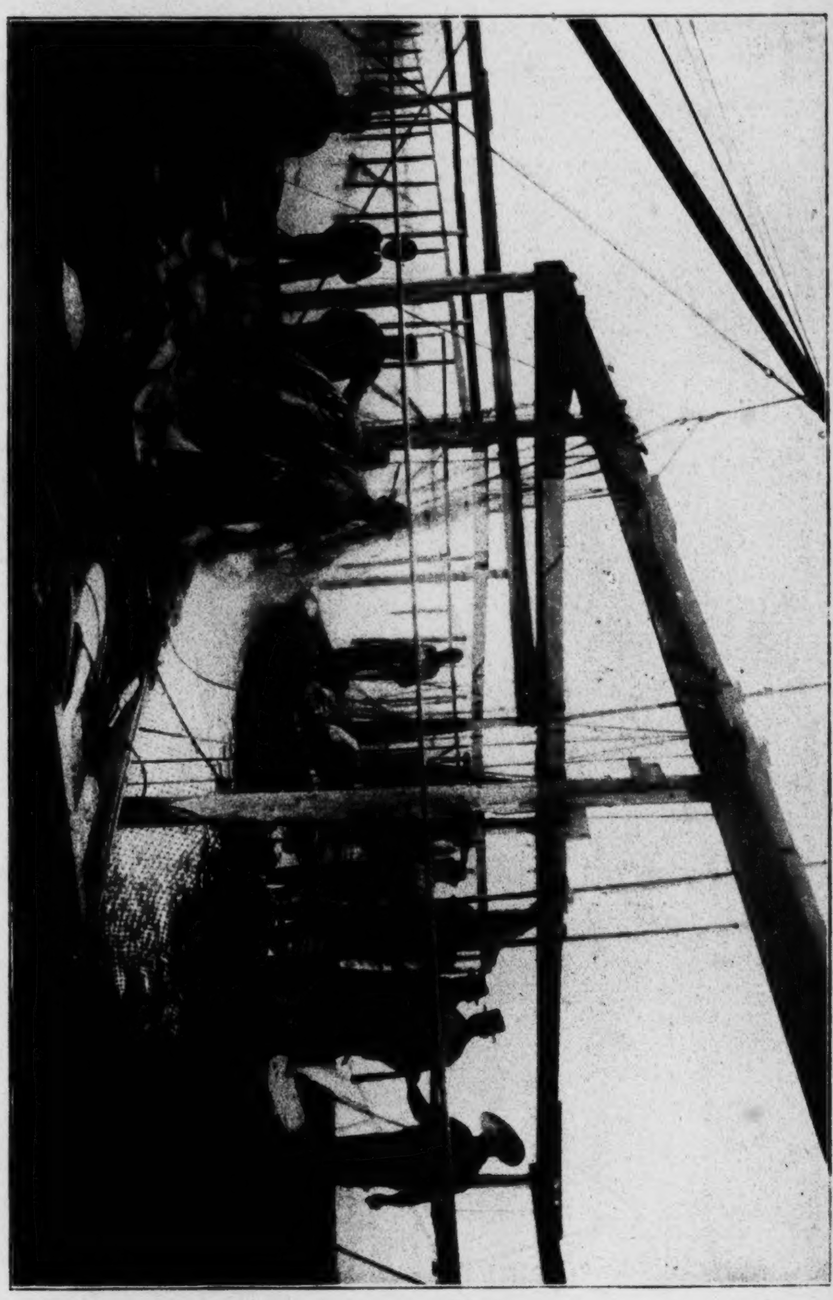
The first locality in the pathway of these fish where profitable trap-net fishing has been found is at the southern end of San Juan Island. Of the schools which turn southward after passing the San Juan group, the only ones recognized commercially are those which enter through Deception Pass into Skagit Bay and River. Trap nets have been used in Skagit Bay for several years, but the catch there also consists in large part of silver salmon and the quinnat.

As the main body of the sockeye moves northward through the Canal de Haro and Rosario Strait, the finest opportunities for the capture of this species are to be expected in that direction. In the former passage, however, no successful trap-net sites had been discovered up to 1896, although trials had been made at Henry and Stuart islands and probably elsewhere. In Rosario Strait, moreover, good fishing with these nets has heretofore been found only in the vicinity of Village Point, on Lummi Island. Trials have been made along the mainland shore north of Lummi Island, but the principal trap-net grounds of the region, and the last before the boundary is reached, are those furnished by Boundary Bay and the waters about Point Roberts. In this locality traps have been in use the greatest length of time and in the greatest number, while their catch has exceeded many times that of all the other similar nets combined.

The Canadian government has constantly opposed the placing of trap nets in British Columbian waters, although much pressure in favor of their construction has been brought to bear. In 1894, however, it yielded to the extent of permitting the building of one such net in Boundary Bay, the number being increased to two in 1895. Taking into consideration their position in the upper part of Boundary Bay, where any fish they might intercept would be headed toward the group of nets in the adjacent waters of the United States, this concession can not be regarded as inconsistent with the general policy of the Canadian government in the matter of this class of fishing. The position of these nets, however, is unfavorable, and it is doubtful if they can be made to pay, especially in view of their distance from the Canadian canneries. Except for a sort of fascine arrangement tried unsuccessfully in 1877, no traps have ever been used on the lower Fraser, and the quantity of sediment and drift brought down by the current would probably interfere with the proper working of such apparatus.

The total number of traps in operation during more or less of the season of 1895 was 21, but not nearly all of these are known to have made good catches, especially of sockeye, and several were practically failures. Twenty-nine additional trap-net sites which had been tried in previous years, but had been abandoned for one cause or another, were definitely located the same year by the Fish Commission party, but the actual number of such sites must have been much greater. New traps were added in several places in 1896, 1897, and 1898, but their exact positions have not been learned. The total number in 1898, however, was much greater than in 1895. The future growth of the fishery can not be predicted. Despite its rapid development it has met with many reverses, and much capital has been sunk. Only a certain proportion of the nets have realized the expectations of their builders, and the location of successful sites has, in most cases, been the result of actual trial, generally following one or more failures,

PLATE 11.



REMOVING SALMON FROM TRAP NET OFF CANNERY POINT, POINT ROBERTS, WASHINGTON, 1895. TO SHOW HEAVY CONSTRUCTION OF THE CRIB IN THE LARGE TRAPS.

as little reliance can be placed upon the existing knowledge of the movements of the fish. How the growth of the industry may affect operations on the Fraser River and the abundance of the sockeye is also an important matter which remains to be determined.

CONSTRUCTION OF THE TRAPS.

The salmon trap nets are constructed on the same general principle as the pound nets of the Great Lakes, consisting of a crib, tunnel, heart, and leader; but they are usually made of a larger size, and experience has dictated some important modifications. The netting is of cotton twine, and is supported by wooden stakes driven into the bottom. Wire netting of galvanized iron, in place of the cotton, for the hearts and leaders, has been suggested as probably more durable, and experiments regarding it have recently been carried on at Point Roberts. Floating traps, such as are successfully employed for salmon and other species in the Gulf of St. Lawrence, have never been tried in this region, but their relative cheapness and the ease with which they can be shifted from place to place are advantages which might commend them to the fishermen of Washington.

The fishing-sites in the track of the sockeye are largely in exposed positions, many of them being open to the full force of any gale sweeping across a wide expanse of water from more than one direction, as is especially the case at Point Roberts. This condition necessitates the building generally of stronger traps than are customarily used in other regions. The stakes are unusually heavy and are often backed by additional piling. The crib, moreover, is frequently strengthened by a capping of timber which binds the stakes together, and this capping may be continued along the top of the heart and even of the leader to a greater or less distance. This construction gives the appearance of great permanency, but it is designed only to meet the requirements of a single season, and it sometimes fails even in this respect, especially if the season be a stormy one. While some of the upper timbers and the netting may be saved, the stakes are seldom, if ever, available for a second season. The latter are rapidly honeycombed by ship-worms and it is not the practice to remove them. They are liable to break in the attempt to pull them from the bottom, and in the course of two or three months they become so thickly covered with barnacles as to chafe the nets badly.

The length of the leader varies according to location and the slope of the bottom, but it is generally much greater than in the Great Lakes, sometimes exceeding a half mile. The cribs are also generally of extra size, rectangular, but not always square in shape, and measured in the several traps examined from 35 to 80 feet on a side. Their depth ranged from 3 to 9 fathoms, dependent upon the depth of water. The hearts are, as a rule, proportionally large for the size of the crib, are sometimes double, one leading into the other, and constitute the most novel feature of the trap. They vary greatly in shape to meet the supposed exigencies of each locality, and often have a leader-like extension of greater or less length, the entire arrangement being planned to intercept and direct toward the crib-opening such of the salmon as do not follow close along the main leader, and to minimize the chances of escape of those which have entered. This construction, the outcome of much experimenting, is said to have very greatly increased the effectiveness of the traps.

There may be an opening into the heart and crib on both sides of the leader, but it seems to be the more common practice to limit the entrance to one side, at least as regards the fishery for the sockeye, in view of the steady and constant movement of this species in one direction while on its passage to the fresh waters. The customary double opening would offer no advantages under these conditions.

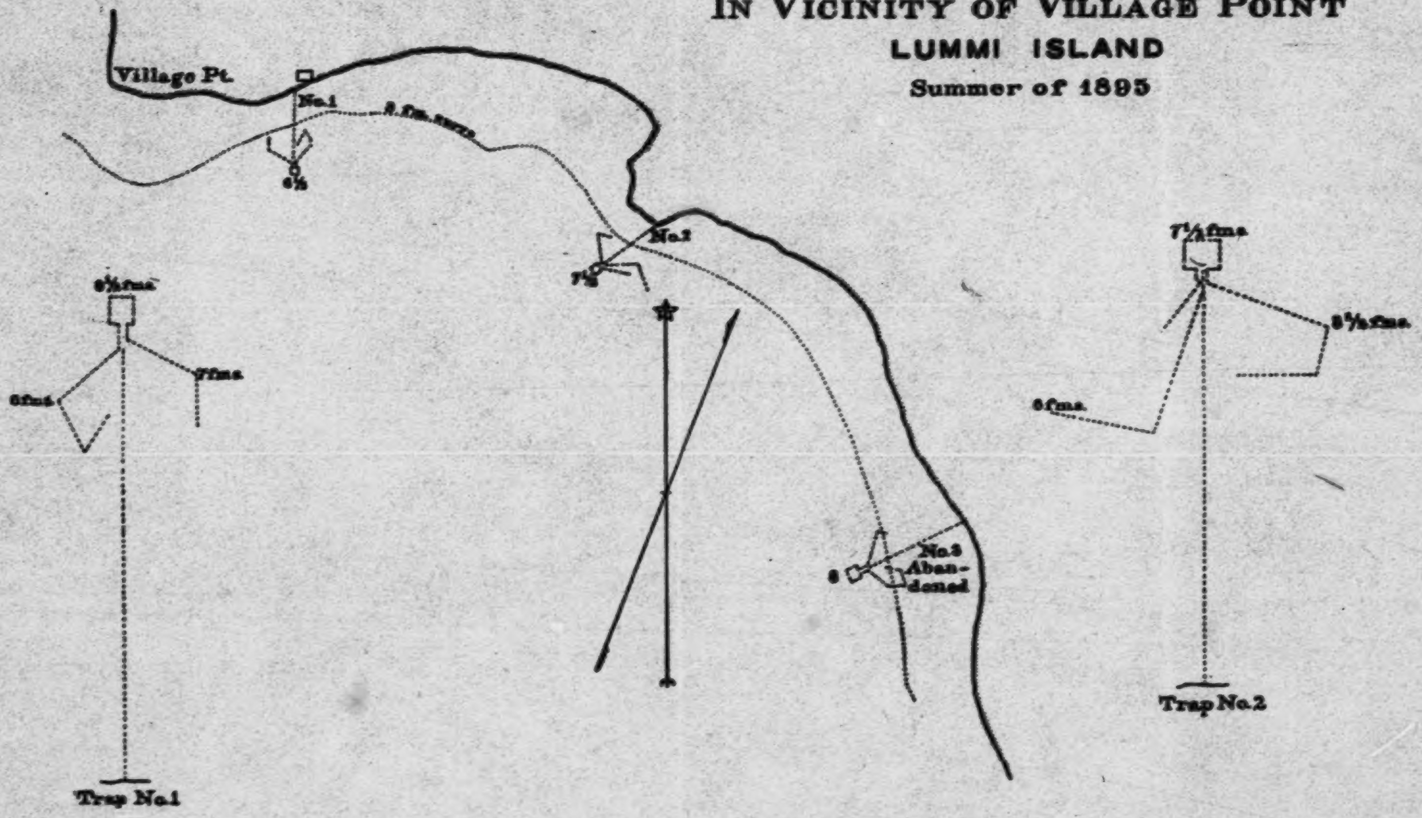
The mesh of the netting is usually 3 inches in the crib and heart, and from 3½ to 4 inches in the leader. Mesh of larger size, from 6 to 8 inches, has been tried in the leaders, but it is said to have proved disadvantageous, owing, in part at least, to the large quantity of coarse seaweed which is often found floating in the water, and which finds lodgment in the larger mesh, tending to clog it and weigh down the net. Observations on the general effect of using the smaller mesh in both the crib and leader are lacking. The gill-net mesh for sockeye on the Fraser River is 5⅝ inches, and it would seem that the mesh in the crib might be increased above 3 inches without danger of gilling adult fish. There would be no object, however, in taking such a step, unless it were found that the present mesh was destructive of young salmon or of other species smaller in size than the sockeye. This fact could readily be determined by careful examination extending through an entire fishing season.

As elsewhere explained, the catches made in the trap nets are sometimes much larger than can at once be handled by the canneries, and while one such catch might be held in the crib for several days, it would prevent continuous fishing during a period when the salmon might be running best. To meet this contingency an adjunct to the crib, called a spiller, has recently been devised, and appears to be coming into quite general use. It is, in fact, an additional crib, square in shape, and connected with the first by means of a tunnel, through which the surplus fish of any catch may be driven. In this way large numbers of salmon may be kept in good condition for a considerable time, fishing may go on uninterruptedly and without loss, and the canneries continue in operation during intervals when the runs are small or have ceased.

DISTRIBUTION AND HISTORY.

The shores first approached by the sockeye which have furnished sites for trap nets are those of the San Juan Islands, but none of these has so far been more than very moderately successful. How many trials have been made there as well as elsewhere throughout the region it has been impossible to ascertain. In 1894 two nets of this character were built on Lopez Island. One was near Fisherman Bay, in San Juan Channel, where it is now thought the sockeye never enter, or, if at all, in

SALMON TRAPS
IN VICINITY OF VILLAGE POINT
LUMMI ISLAND
Summer of 1895



Details of Traps 1 and 2 on scale of 200 feet to 1 inch quantities too small to be appreciable. The other was off the south side of the island, in the vicinity of Long Island, where sockeye were observed in 1893, though they failed to appear, or at least to be taken, in 1894. The same year there was a trap at Reed Harbor, Stuart Island, which also proved unsuccessful, and none of these three places has since been tried.

In 1895 there were again apparently only three traps among these islands, one of which was on Henry Island, near Roche Harbor, but as the site was evidently unfavorable for the purpose it was soon abandoned. The other two were located off the south side of San Juan Island, just west of Cattle Point light-house. The eastern one was built on the northwestern edge of Salmon Bank, the other being about three-fourths of a mile farther west. The western began near the beach and extended off a distance of about 3,200 feet, while the eastern started some distance from shore and had about 2,900 feet of leader. The extreme depth of the cribs was about 7½ fathoms. It is said that the western net took but few sockeye, although the eastern did fairly well. Many humpback salmon and small quantities of other species were also caught. It was proposed in 1896 and 1897 to increase the number of traps among the San Juan Islands, but no definite information as to the sites occupied has been obtained.

As to the waters directly east of the San Juan group, trap-net fishing has been mainly limited to Skagit Bay and Lummi Island. In 1895 there were two traps in Skagit Bay, both of moderate size, one being operated at Demock Point, the northwestern extremity of Camano Island, the other at Hunot Point, near the southern end of Fidalgo Island. In previous years the following sites, as well as others, had been occupied: Alaki Point, at the northeast end of Whidby Island; the west side of Kiket Island; Tosi Point and Hunot Point, on Fidalgo Island; and the shore between La Conner and Goat Island. The traps in Skagit Bay are placed to intercept the run of sockeye which, entering through Deception Pass, are making for the Skagit River. Silver salmon and the quinnat are also taken here in abundance, and supplies are shipped to canneries in other places as well as to the fresh market at Seattle. By 1897 the number of traps in operation had been increased, and the industry had assumed much greater importance owing to the establishment of two canneries at Anacortes.

One small trap net was reported to have been fished in 1895 near Edison, in Samish Bay, and another was projected for William Point, Samish Island, in 1896. It was not learned for which species these nets were planned.

On the west side of Lummi Island, south of Village Point, three trap-net sites, about equal distances apart, had been occupied up to the close of 1895, the farthest being about 1½ miles from the point, the nearest within one-fourth mile. They lead off from the shore from 637 to 725 feet into depths of 6½ to 8 fathoms. One was built upon for the first time in 1895, but the others are of older date. One of the latter, the farthest from the point, has been abandoned. The remaining two, however, are said to be favorably placed, but while both were put to use in 1895, an injunction obtained against them by the Indians prevented their employment during most of the season. This was due to their location inside of and adjacent to one of the favorite reef-net fishing-grounds, which the Indians claimed was being injured by their proximity. Here also, in 1897, a marked increase was shown in the extent of trap-net fishing.

An elaborate trap built in 1894 at Sandy Point, on the mainland, a short distance north of Lummi Island, is reported to have taken no sockeye; but while the site was not occupied in 1895, it was proposed to utilize it again in 1896. Projected traps for 1896 were also to be located at Cherry Point and Point Whitehorn, still farther north, on the mainland. One was erected in 1895 at Birch Point, but was used for only a few days. It was intended to rebuild it on a larger scale in 1896.

Point Roberts.—The advantages of the waters about Point Roberts for trap-net fishing will be understood from the account of the movements of the sockeye after reaching Boundary Bay. The number of fish which pass around the point and the regular course taken by the schools combine to make this locality, as regards the species named, the most favored of any in the salt waters of the region.

Point Roberts is about 3 miles wide along its southern shore, which is nearly straight, and between 4 and 5 miles long north and south, about 2 miles in this direction lying south of the international boundary line formed by the forty-ninth parallel of north latitude. On the east side it is bordered by Boundary Bay, which, including Semiahmoo Bay, has an extreme width of about 11 miles. North of the boundary this bay is very shallow, being nearly everywhere less than 3 fathoms deep. The width of the shallower water narrows in the direction of the southeastern corner of Point Roberts, known as Cannery Point, south of which, however, there is an extensive kelp-covered ledge, long a favorite fishing-ground of the Indians. After passing this ledge the 3-fathom curve lies close inshore along the south side of Point Roberts and until after rounding its southwest corner, when it again bends offshore quite abruptly as the broad bank off the mouths of Fraser River is approached.

The facilities for the building of trap nets in this locality are mainly determined by the contour of the bottom. The shallow water off the east side of the point gives opportunity for greatly multiplying their number, but when the depths are slight, the conditions are generally least favorable for the movements of the sockeye, and much of the ground is practically valueless. More fish are said to be taken along the edge of the deep water than elsewhere, and those nets fish best which are in the deep water or lead into it. The winds also are a factor as regards the shallow areas, as the nets up in the bay do nothing when there is a northwest wind, while a southerly wind, blowing on the shore and causing rough water, seems to drive the fish in. Cannery Point is considered to present the best advantages yet discovered, and much larger catches of sockeye have been made directly in front of it than in any other part of the salt water. Along the south side of Point Roberts long leaders are not possible, and the cribs are invariably comparatively near the shore, but the fish also keep correspondingly farther in, and after Cannery Point the next best sites are said to be in the neighborhood of the southwest corner. West of the point, up toward the boundary line, the bottom is again suited to long leaders.

Trap-net fishing was started at Point Roberts some years before it was taken up at other places. The first net of this kind was built by John Waller, about 1880, off Cannery Point, a short distance north of the Indian reef, and this position appears to have been more continuously occupied for the purpose than any other. For nearly a decade, however, such operations as were carried on were scarcely more than experimental, and the results for the most part were small. While we have little information on the subject, the traps as first constructed seem not to have been entirely suited to the capture of the sockeye, and the value of the different sites had yet to be learned. In Waller's trap the crib is said to have been only about 20 feet square, while the leader, measuring some 900 feet long, did not approach nearer than 300 feet from the shore. It was set only during the sockeye run, the greater portion of the catch being sold to the canneries on the Fraser River, while the remainder were salted. Mr. Waller was succeeded about 1885 by a practical fisherman from the Great Lakes, who is still at Point Roberts and who has done much to bring the net to its present state of perfection. He made use of at least the same general position as Mr. Waller, but in 1887 a second trap was added on the eastern side, much nearer the boundary line. Until 1891 the number of these nets does not seem to have been increased beyond two, the catch by this means continuing small and being disposed of as in the beginning. In the last-named year, however, a small cannery, the first one in the region, was built at Semiahmoo, at the eastern end of Boundary Bay, and arrangements were made to obtain the necessary supplies of fish from Point Roberts. This led to the erection of one or two, possibly three, additional traps. In 1893 a second cannery was built, this one occupying the southeast corner of the Point, and the number of traps was increased to 13, 11 being operated by the two canneries, and 2 independently. Before the next season both canneries had passed into the control of the Alaska Packers' Association, which made use of 12 traps during 1894, while 4 were under independent management, making 16 in all south of the boundary line. During this year the first net was placed in the Canadian waters of Boundary Bay, being located close to the line.

In 1895 there were 33 trap-net locations about Point Roberts, of which 23 were east of the Point in Boundary Bay, and the remainder south and west of it. This number included both the traps in use and those of previous years whose positions were still marked by more or less of the old and generally much decayed stakes. One object in leaving the latter in place, besides the trouble and expense of removing them, was to show a preemption of the grounds they occupy, and thus, as far as possible, to prevent encroachment by outsiders. The better sites, to the extent that they have been disclosed or that a foothold could be gained, are the ones now occupied, and the good grounds seem already to be pretty thoroughly controlled by those in possession, although further experience may suggest other profitable locations. The extent of fishing at this point, however, will probably continue to be largely regulated by the capacity of the canneries near at hand, or rather by their output as dictated by market conditions, unless competition should arise to stimulate an active rivalry.

Eleven traps were in operation to the east of Point Roberts in 1895, two of these being in Canadian waters and the majority of the others directly off Cannery Point. Seven were controlled by the canneries at Point Roberts and Semiahmoo, while the catch from the remaining four was disposed of on the Fraser River. These traps were irregularly distributed to a distance of about 2 miles from the shore of the Point, three being united in one continuous string and two in another, the remainder being placed singly. The string of three traps extended off from the shore of Cannery Point in a southeasterly direction a distance of about a mile, paralleling the northern edge of the Indian fishing-ledge elsewhere described. The inner trap had a length of about 2,500 feet, the second of about 1,500 feet, and the outer one of about 1,000 feet. The cribs were large and were located successively in depths of 5½, 6½, and 7 fathoms. In none of the other traps on the east side did the inner end of the leader approach near to the land, and in most cases it was a considerable distance off, while the depth of water at the several cribs ranged from 3 to 8½ fathoms.

The direction given to the leaders is based upon the experience of the fishermen that the sockeye appear to enter Boundary Bay well to the east, make a broad sweep westward and then turn somewhat abruptly southward so as to pass out quite close to Cannery Point. The leaders in the outer and northernmost traps may extend north and south, but they generally deviate from this course so as to trend more or less northwest and southeast. Farther west and south, however, they usually run more nearly east and west, but never exactly so, and altogether there is a very great variation in the direction given them. The Canadian nets are rather out of the course of the sockeye, and their catch is largely dependent on the direction of the wind, which is also the case with the more northern nets south of the boundary. The expense of transporting fish to the Fraser River also works to the disadvantage of the Canadian nets.

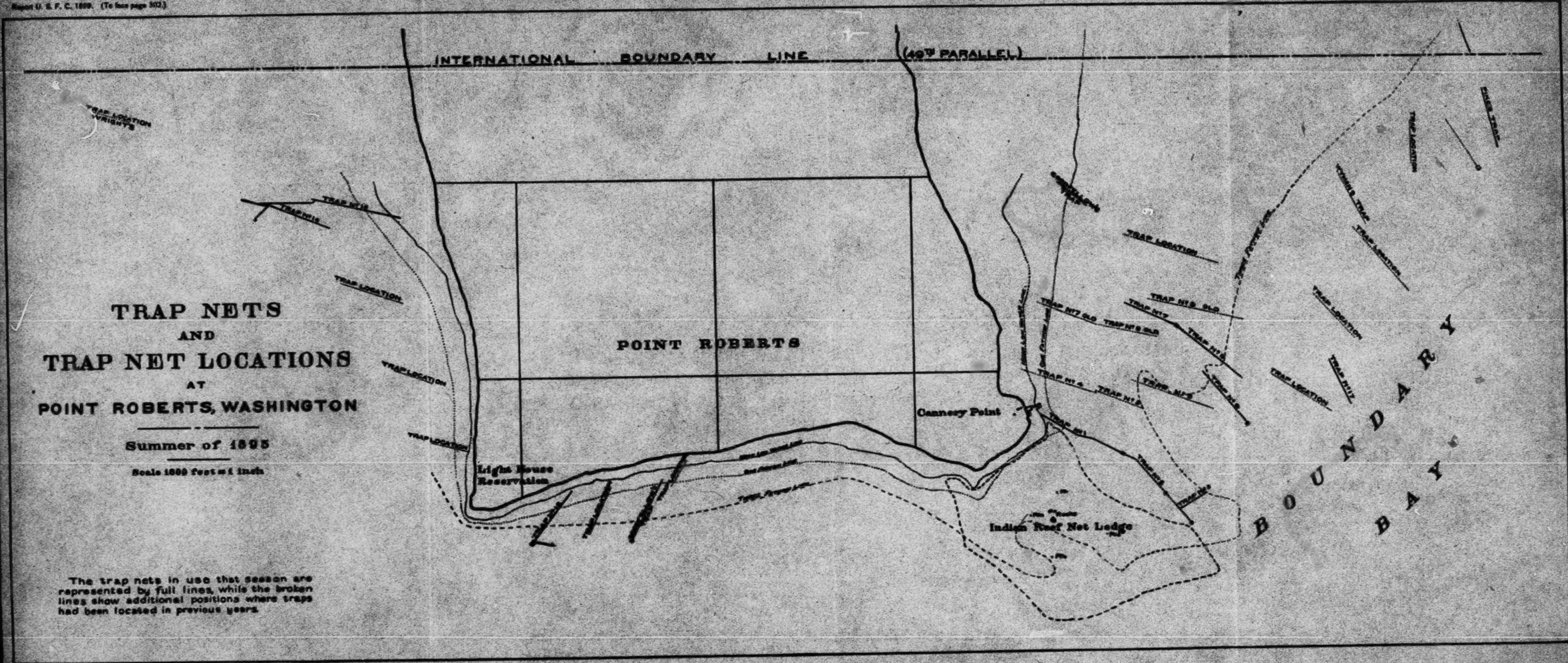
The two traps in operation off the south shore of the Point in 1895, both single ones, were situated near its southwest corner, which is considered to offer the best advantages next to Cannery Point. The abrupt slope of the bottom in this locality necessitates the use of short

TRAP NETS
AND
TRAP NET LOCATIONS
AT
POINT ROBERTS, WASHINGTON

Summer of 1895

Scale 1000 feet = 1 inch

The trap nets in use that season are represented by full lines, while the broken lines show additional positions where traps had been located in previous years.



leaders, not exceeding 1,800 feet, which begin near shore and extend into depths of 5½ and 7 fathoms. Off the west coast there were also only two single traps in 1895, both being well up toward the boundary, and off shore. They had comparatively long leaders extending over the edge of Roberts Bank, the cribs being located in depths of 6½ and 9 fathoms, respectively, and at distances from shore of about 3,200 feet and 1½ miles.

In 1897 and 1898 many additional trap nets were in use about Point Roberts, but their number and exact location have not been ascertained. The catch of sockeye in the former year was very large, and the capacity of the region was shown to be much greater than had been anticipated.

SEASON AND CATCH.

The canneries obtaining their supplies at Point Roberts desire only sockeye salmon, and take other species only when the sockeye catch is insufficient to meet their requirements. The trap nets at that place are therefore built almost exclusively for the capture of the sockeye, and, in view of the expense attending their construction and maintenance, it is doubtful if any would be used there except for the presence of this species. The season when they are set is mainly limited to the period during which the sockeye run continues, generally beginning between the first and middle of July and closing between the middle and end of August.

In 1894 and 1895 one or two traps are said to have been set for the quinnat salmon, commencing between the 10th and 15th of June, but as the weather about Point Roberts is likely to be stormy as late as that time, the risks attending the working of the traps have discouraged their use during the quinnat season. To maintain an active spring fishery for the quinnat by this means would require a special strengthening of the nets, increasing the expense, while at the same time there would be constant danger of their serious injury or destruction. The prevailing summer winds are northwesterly, but easterly winds occasionally occur, producing rough water in the neighborhood of the nets in Boundary Bay and making it difficult or impossible to lift them for a day or two, especially the more northern ones in the shallower water. If the sockeye season has been unfavorable, a few of the traps may be left in position during a part of September, in order to cover more or less of the run of silver salmon in case it is desired to fill out the pack with that species.

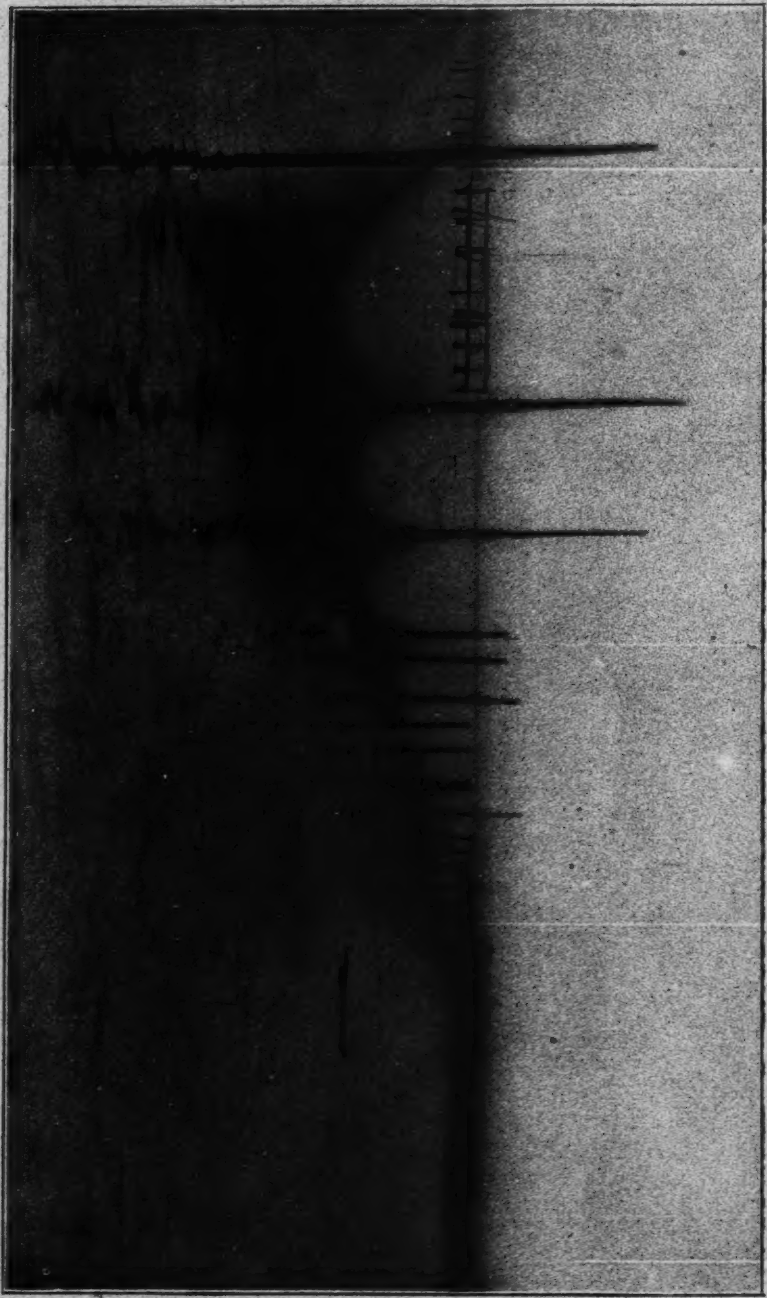
As an indication of the recent rapid growth of the trap-net fishery at Point Roberts, it may be noted that in 1892 the catch of sockeye by that means was reported as about 37,000 fish, while in 1895 it had increased to about 680,000 fish, of which by far the greatest quantity was taken in the nets of the nearby canneries. The number of spring salmon caught during the latter year was reported at less than 5,000. Humpback salmon are taken in connection with a part of the sockeye run in very large quantities, but they are seldom, if ever, used for canning.

Before the building of canneries at Semiahmoo and Point Roberts the Fraser River furnished the only market for disposing of the fish in fresh condition; but the establishment of canning operations near the location of the traps has changed all this. In 1895 the river canneries received out of the total catch of 680,000 sockeye only about 80,000, of which 30,000 came from the nets in the Canadian waters of Boundary Bay and 50,000 from three nets south of the boundary line. In good years, when the Fraser River catch is ample, there has been no need to draw on Boundary Bay, although contracts previously made may have to be carried out, while in poor years there is a desire to retain at Point Roberts as much as possible of the sockeye catch made in that vicinity. The Fraser River canners are, as a rule, opposed to handling sockeye from Point Roberts, except in cases of emergency, for the reason that the fish are apt to deteriorate greatly in condition during transportation, when they are piled in large scows and towed from the fishing-grounds to the canneries. The season, being the height of summer, is unfavorable, and the fish are often so soft upon reaching their destination that no use can be made of them. This happens most often in years of large catches, when the competition for markets is very great, and when the loss of fish from this cause has sometimes been very heavy.

There is a marked inequality in the size of the sockeye catch at Point Roberts, as in other localities, from time to time during the same season, due to fluctuations in the abundance of the fish, as elsewhere explained. Small catches for a period may be followed by excessive ones (amounting occasionally, it is said, to from 40,000 to 50,000 sockeye in a single day by the principal nets at Point Roberts), the latter sometimes causing a surplus which the canneries can not utilize immediately. In this respect the trap nets possess an advantage over the gill nets, in affording the means of releasing or keeping the fish alive, through the crib itself or the spiller. The practice has also been followed of removing the surplus catch to cold chambers awaiting use.

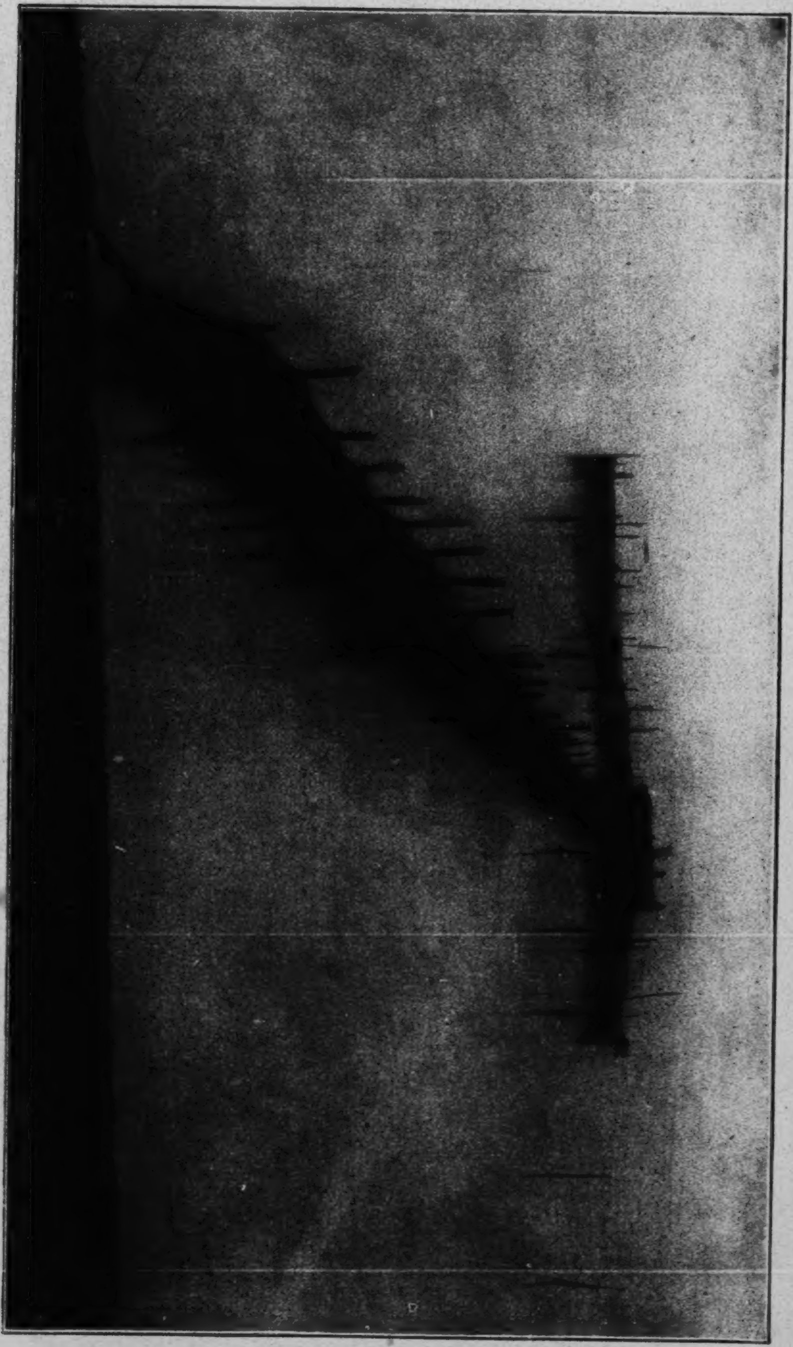
Notwithstanding the special advantages which the traps present in this respect, there is what seems to be well-founded complaint of the waste of many fish through their means, including even the sockeye in seasons of great abundance. The charges recite that this species is sometimes retained in the nets until no longer fit for use, and also that at times only a small proportion, the choicest parts, of each fish are utilized for canning, the remainder being rejected. As it is difficult to imagine the willful destruction of so valuable a fish simply, as it is claimed, to prevent their coming into the possession of others, it is to be hoped that the circumstances are not so bad as represented. The danger of the extermination of the species is too great to justify a resort to any such methods and most stringent measures should be adopted to prevent a waste in this direction.

The principal destruction is probably of other species of salmon and of fishes belonging to other groups, which are trapped in conjunction with the sockeye and in the removal of which no pains are taken to



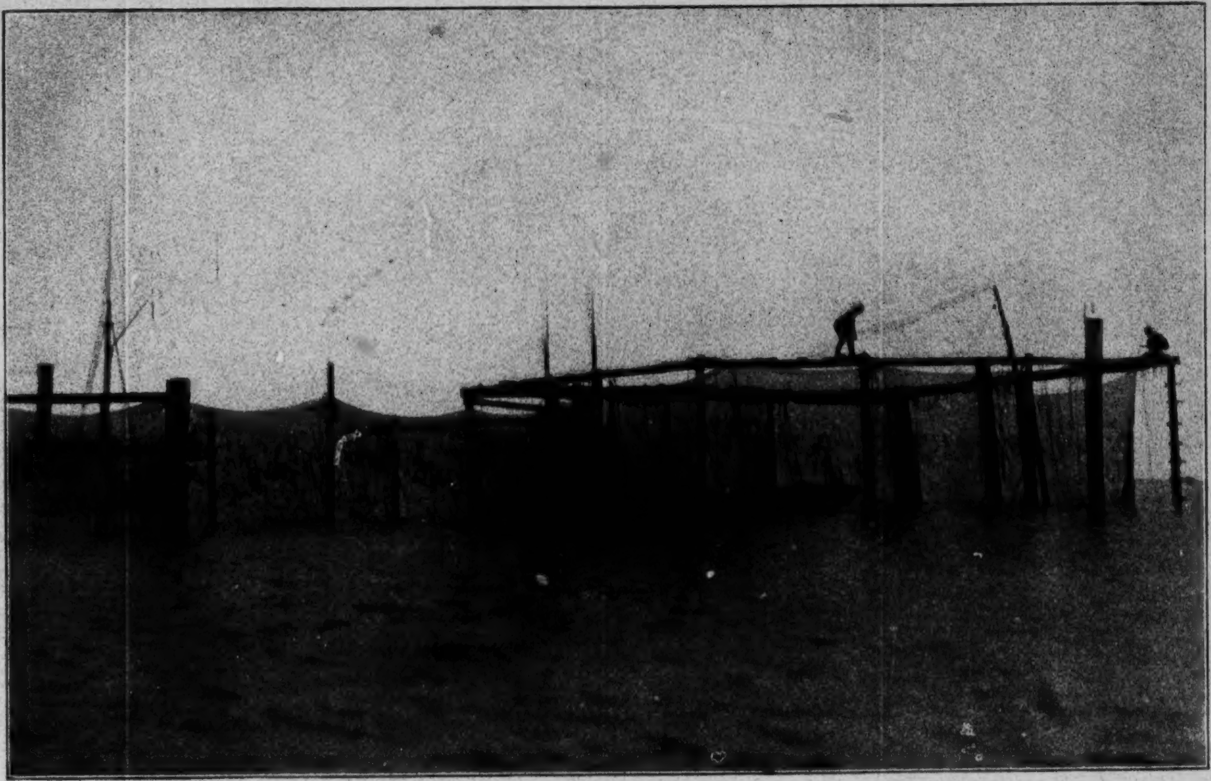
TRAP NET AT HUNOT POINT, SKAGIT BAY, WASHINGTON, 1895. SEEN FROM THE SHORE.

PLATE 15.



TRAP NET AT DEMOCK POINT, COMANO ISLAND, SKAGIT BAY, WASHINGTON, 1895. SEEN FROM THE SHORE.

PLATE 16.



CRIB OF TRAP NET AT DEMOCK POINT, COMANO ISLAND, SKAGIT BAY, WASHINGTON, 1895.

return them alive to the water. This results mainly from the large size, generally, of the catches and the difficulty of sorting them during the operation of emptying the crib. With the exception of some of the largest forms, it is customary to load everything on scows by means of large dip nets or by reversing the crib net, after which the desirable parts of the catch are selected out and the remainder thrown away—nearly all being dead by this time. Experience with trap nets in other regions shows that some discrimination can be made during the progress of removal, especially when the species to be saved are large and easily recognized, as is the case here, but in so doing the work is much prolonged and the expense increased. In a new region, so rich in resources as the one in question, where use can be found for only the choicer products and competition is exceedingly keen, it is questionable whether such exacting regulations of this character would be either wise or expedient at present. In fact, regulations looking to the release alive of any part of the catch of trap nets seldom contemplate in any region the assorting of the catch by hand, but only the escape of the smaller fish through proper restrictions upon the size of the mesh. This is a question which indeed deserves consideration in connection with the traps of the Puget Sound region.

Among the species said to be destroyed in quantity are the quinnat, when off color, humpback and other salmon, sturgeon, herring, smelt, and flounders. As it is not possible to determine the color of the quinnat until it has been cut, there seems to be no way of affording the protection which it equally lacks when taken by other methods. Dogfish, which are sometimes captured in large numbers, are returned alive to the water, and a sale is springing up for the sturgeon, though many have been wasted in the past.

GILL NETS.

BRITISH COLUMBIA.

Gill nets are the principal appliances of the salmon fishery in British Columbia, but in Washington they are less important than the traps and seines. In Canadian waters, in fact, commercial fishing for salmon with nets is restricted to the use of drift gill nets, except in the upper part of Boundary Bay, where traps have been allowed, and in one or two northern localities, where seining is permitted because of the clearness of the water. The drift-net grounds are mostly limited to the Fraser River and the adjacent part of the Gulf of Georgia, where the advantages for fishing are much greater than in any other section of this entire region. Not only does this river and its approaches have the largest runs of all the species of salmon, but during the most important months for fishing they present together an exceedingly large area of highly discolored water in which gill nets may be used as effectively in the daytime as at night. This discoloration, which results from the floods caused by the melting snows among the mountains, commences generally about the middle of April and lasts until early in the fall, thus covering a large part of the quinnat run and all of that of the sockeye. Before it becomes sufficiently marked to obscure the nets, the quinnat fishery is mostly carried on at night.

This drift-net fishery was being carried on in a small way as early as 1875 at least, but in the beginning it seems to have been entirely confined within the river. Finding, however, that good fishing by this means could be obtained outside the delta, the fishermen began by 1885 to resort to the "sandheads" off the south arm, from which point the area of their operations has been extended until by 1891 it reached as far offshore as does the intensely muddy water of the Fraser. Wherever this condition exists the sockeye can be taken in drift nets as readily and in as great abundance as in the river itself. This extension of the grounds has given opportunity for a greatly increased catch, and has caused the bulk of the fishery to be centered within a radius of 6 or 8 miles of the river mouth, upstream in one direction and out in the Gulf of Georgia in the other.

Drift-net fishing in the Fraser is restricted by law to that part of its course which is influenced by the tide, the upper limit being placed at Sumas River, between 50 and 60 miles above the mouth of the main river. Comparatively little, however, is done above New Westminster, though there are in this upper section a few good drifting-places during high water, where the quinnat are taken in the spring and the sockeye in July, but generally in August the river becomes so low as to interfere with operations. During a short period in each week of July and August, immediately following the weekly close time, drifting may be carried on largely about New Westminster and thence downstream, but as a whole by far the greater part of the fishery is limited to the lower 6 to 8 miles of the river and the outside grounds. This is explained by the fact that the current is not so strong below, there is more room and more certainty of a sailing breeze upstream to renew the drift, and competition naturally impels the fishermen to seek the grounds nearest to where the fish first appear, in their efforts to secure some advantage. The canneries have also become mainly concentrated along the lower part of the river, especially in the vicinity of Ladner, and at Steveston, where they are convenient to the fishing-grounds now mostly resorted to. Fishing is carried on in all three branches of the delta, the main channel, the North Arm, and Canoe Pass.

Outside the river there are no legal restrictions upon the extent of the grounds, their limits being solely defined by the opportunities for securing fish. As explained in the account of that species, the sockeye assemble in front of the delta, coming apparently both from the south and west, and occupying a considerable area both on and off the edges of the bank which stretches from Point Grey to Point Roberts. The discolored water permits the use of drift nets as far north as Point Grey, as far south as the boundary line, and to a distance of at least 5 or 6 miles offshore in the direction of Vancouver Island. The heaviest part of the fishing is done off the main entrance and Canoe Pass, toward which the fish are working, but during a trip from the delta to Point Roberts, at the height of the sockeye season in 1895, the boats were observed to be also scattered elsewhere in all directions as far as one could see, to near the boundary line, south of which they do not go. There were at least 400 or 500 boats outside on that occasion, and the scene presented was one of great animation. While the nets are set with reference to the current, they soon take devious courses, and in places were so close together that the tug on which we were had difficulty in picking its way among them.

Owing to the generally unfavorable weather in the spring, there has been practically no fishery for quinnat on the outside grounds at that season, but in the fall this species may be taken there to a small extent.

The length of the drift nets in British Columbian waters is limited by law to 150 fathoms, and the most of those in use are probably of about that size. There is no restriction upon their depth, but custom fixes it at 50 to 55 meshes, though some are narrower. Two sizes of mesh are recognized by law. The larger, intended for the quinnat salmon, measured 7¾ inches in extension, until 1897, when it was reduced to 7 inches, and may be used from March 1 to September 15. The smaller, designed for the sockeye, silver salmon, etc., measures 5⅞ inches, and may legally be employed from July 1 to August 25, and again from September 25 to October 31. Between September 15 and 25, and between November 1 and March 1, all salmon fishing with nets is prohibited. The quinnat nets are employed mainly in the spring and early summer, but also to some extent in September, when the quinnat run is smaller and the fish are not in so good condition. The smaller mesh is used mostly during July and August, when the sockeye are present and the canneries are in active operation. The close season, beginning August 25, is to permit the last of the sockeye schools, in which the fish are well matured, to reach their spawning-grounds unmolested. The fall season of the small-meshed nets allows for the capture of the silver salmon, but the fishery at that time is not extensive, as the demand for this species is very much less than for the sockeye.

The twine of which the nets are made is of the best flax, but being loosely laid has a very coarse appearance compared with that used for gill nets in the Great Lakes and elsewhere in the East. The nets constructed of it, however, are said to be better adapted to the large catches of heavy fish so generally obtained on the Fraser River, although the fine hard twine is best for clear water. The cost of the nets fully rigged is about $100 apiece. They are lightly tanned and sometimes a little tar is used upon them. With care they can be made to last three or four years, but with the ordinary hired fishermen their life is generally measured by a single season. They are fitted with lead sinkers and wooden floats. The buoys are sometimes of wood, but square tin oil cans are very commonly employed for this purpose.

The boats are mostly small skiffs, about 20 feet long, generally manned by two, occasionally by three, persons. In recent years the

Columbia River boat has been introduced and is now used to a considerable extent in the lower part of the river and outside. Its breadth and centerboard make it much safer for the more exposed places.

All gill nets in British Columbian waters are, in accordance with law, used adrift. This method appears to be best suited to most of the requirements of the region and has given entire satisfaction. The current in the Fraser River is generally too strong for set nets, and with the large number of nets there employed only the one method of fishing them would be advisable. All nets are drifted at the surface, each being handled by a single boat, to which it is attached at one end, the other end being indicated by its buoy.

Up to 1891, inclusive, the number of drift nets in use was limited to 500. Since then, however, licenses have been issued to all bona-fide fishermen, British citizens and residents, who make application. The canneries and other establishments dealing in salmon are allowed several nets apiece, but each independent fisherman is entitled to only a single net. The number of licenses issued and the total length of the nets employed each year since 1891 have been as follows:

Year.	Number of nets.	Total length of nets in yards.	Year.	Number of nets.	Total length of nets in yards.
1892	721	232,580	1895	1,733	528,006
1893	1,072	355,900	1896	....	693,801
1894	1,666	503,900	1897	....	709,400

To insure their identification the boats of the independent fishermen must be marked with their license number, but canneries and dealers have each their separate series of numbers, as each receives only a single license for all its boats.

A varied nationality is represented among the drift-net fishermen, including Indians and negroes, there being a very large number of the former. The arrangements with them differ. Some own their boats and nets and dispose of their catch by contract; others are supplied with their outfit by the canneries and fish on shares, while others again, the Indians especially, are employed on day wages. The independent fisherman in possession of an outfit is supposed to fish it himself, and his hours are measured by his endurance. The canneries, however, generally hire two gangs for each of their boats, in order that they may be kept at work both day and night. The licenses do not define the position which each fisherman may occupy with his drift net. The law provides, however, that the nets shall be kept at least 250 yards apart and shall not be used so as to obstruct more than one-third the width of the river, but it has been manifestly impossible to comply with these regulations—the first, especially—since the number of nets has increased so greatly; and the second, because in many places the width of the river is less than three times the length of the nets.

The fishermen are left to arrange these matters among themselves, and whether they do so by tacit understanding or not, there is little or no interference among them. Each selects, so far as he can, what seems to him the best location, and may change it from time to time. As the nets are floating no fisherman has a clear piece of ground to himself, but they follow one another in groups over the same ground, and move upstream again after completing their drift or after having made a certain distance. The drifts may vary from 1 to 2 or 3 miles, and are sometimes shorter, dependent upon the abundance of fish and other circumstances. The best conditions for drifting are said to occur at slack high water, whether at night or in the daytime, and most fishing is done at that stage of the tide. The nets then hang more vertically and it is the general opinion that there is also then a better movement of the fish. When the river is high and swift they attempt to fish more along the sides and in the eddies, as the fish seem to seek the places of least resistance, but when it falls they do better in the channels.

The nets are customarily set at right angles to the current, but as the velocity of the latter varies at different points across the channel and eddies frequently occur, the nets do not long remain spread out in the direction intended, but take irregular courses with a general tendency to trend up and down stream. In some places, where bars so exist as to cause the fish to move crosswise of the river, the nets may do best in the latter position, but, as a rule, they are not allowed to head off much before lifting begins. On the outside grounds it is also the practice to set across the current, and some of the most successful drifting is there done by starting a net near the mouth of one of the river channels and allowing it to be carried as far as the current serves, which may be a long way when the river is in flood.

An opportunity for studying the effect upon the salmon runs of the extensive drift-net fishing now carried on in the Fraser River is afforded by the weekly close times, but practically no attention has been given to the subject. All fishing being prohibited from 6 o'clock Saturday morning until the same hour Sunday evening, the salmon are given an unobstructed passageway up the river during thirty-six hours out of every seven days. The movement of the fish is not, of course, uniform or even continuous throughout the season or any extended part of it. While, therefore, it is impossible, without the necessary observations, to pass definitely upon the matter, yet at the end of each weekly close time it is expected that a proportionally much greater quantity of fish may be found in the neighborhood of New Westminster than at other periods of the week. On Sunday evening, as the time for fishing reopens, the work begins actively about New Westminster, the river being covered by as many boats as can safely operate, and the catch per net being as good as at least the average on the lower drifting-grounds. Such success does not continue long, and during the remainder of the week comparatively few boats remain on the upper grounds.

In the interest of the protection of the fish it would be important to ascertain what proportion of the run is removed by the large amount of netting used on the Fraser River during the past few years. Such information as we possess is very indefinite at the best, but the evidence presented by the circumstances attending the weekly close time argues strongly in favor of the continuance of that protective measure. In illustration of this matter may be cited the catch by the drift-netters during the night of Sunday, August 16, 1895, which was said to have exceeded 700,000 sockeye, the largest single night's catch on record up to that time at least.

WASHINGTON.

Gill nets are employed in both the salt waters and rivers of Washington, but much less extensively than in British Columbia. Their use extends quite largely to the clear open waters, where they are only serviceable at night, and they are fished both set and drifting. The fishery is for the most part somewhat irregular, and aside from a few localities is prosecuted in a small way at scattered places, much of the catch being disposed of locally, although a good part of the fresh supply, especially of quinnat, sent to the larger markets, such as Seattle, is the product of this class of nets.

Skagit Bay and River seem to have been the seat of the most important operations of this character. About 50 nets were employed on the latter in 1894, 35 belonging to white men and 15 to Indians. The set nets measured 15 fathoms long and 15 feet deep, some having a 5¾ and others a 9 inch mesh; they are anchored in little indentations of the river bank to avoid the swift current as much as possible. The drift nets were 50 fathoms long and 15 feet deep, with a 9-inch mesh, being used mostly for the quinnat. The nets were larger on the bay, some measuring 125 fathoms long and 18 feet deep, a 9-inch mesh being used for the quinnat and a 5¾ or 6 inch mesh for the sockeye and silver salmon. Since 1895 there has been a large increase in this fishery, which has mainly been brought about by the establishment of new canneries, especially at Anacortes. The gill-netters, however, have had difficulty in competing with the trap nets, which afford the cheapest means of taking salmon here, as at Point Roberts, and in 1897 a strong but futile effort was made to secure the passage of a bill prohibiting the latter class of apparatus.

Boundary Bay is another relatively important place for gill-netting, and in other places about the shores, as well as in many of the rivers, this method is also followed, the extent of fishing varying in accordance with the opportunities and the demands. In some places only two or three small nets may be employed to supply the local wants, while in others the advantages for shipping or canning interests may stimulate a considerable activity. Even in such small rivers as the Elwha and Dungeness, on the south side of the Strait of Juan de Fuca, having only 2 or 3 miles of level course, several nets may be in use, and such fish as are not required at home find their way to the Seattle market.

PURSE SEINES.

The purse seine is, next after the trap net, the most important appliance used for the capture of salmon in the United States waters, where it is said to have been introduced about 1886. It resembles the purse seine of the Atlantic coast, but differs from it in some particulars. Its construction and mode of use have been described in the Bulletin of the United States Fish Commission for 1888 (pp. 55, 56), and in the annual report of that Commission for the same year (pp. 254–256). The nets are very large and therefore of great capacity, the catch often amounting to several thousand salmon at a single haul. In those whose measurements have been brought to our attention the length varies from 150 to 250 fathoms and the depth from 14 to 25 fathoms in the bunt. The mesh is from 2½ to 3 inches. Two boats are required for operating a purse seine—one for setting the net, the other, a scow, for pursing it, the latter also having accommodations for the catch.

Purse seines seem not to be well adapted for taking the sockeye, which are apparently too alert and active to be readily captured by this means, although small quantities may sometimes be so obtained. They appear to be employed mainly for the silver salmon, but also to some extent for humpbacks and dog salmon. It is the only kind of apparatus, aside from hooks and lines, that can be utilized in the open waters at a distance from the shores, and as the salmon of certain species may school anywhere it is destined to remain one of the most important fishing methods, especially for supplying the large catches demanded by the canneries.

The most important fishery with these nets, having its principal headquarters at Seattle, has been carried on throughout the upper part of Puget Sound from the vicinity of Everett to Commencement Bay, and to some extent in Hood's Canal. In 1895 Seattle had at least 11 purse seines in use, and in 1896 probably not less than 20. Keeping track of the schooling fish, many of the nets are often concentrated in a single place, covering the water over a considerable area and making large catches. Although chiefly operated in the interest of canneries, the fresh and salt markets also obtain abundant supplies from this source. Single seine hauls in the upper part of the sound frequently exceed 1,500, and may reach over 2,500 silver salmon. The catch of the gang of nets belonging to the Seattle cannery is said to have averaged 12,000 salmon daily during the height of the season of 1895.

In other parts of the region purse seines have not been as systematically employed. Some have been used about the San Juan Islands, and in 1895 they were first tried in the Strait of Juan de Fuca, with the object of obtaining supplies for the cannery established that year at Port Angeles. The fishing-ground was mainly in the vicinity of that place, but sets were also made near Race Rocks and elsewhere in the eastern part of the strait. About Point Roberts a few purse seines seem to have been operated nearly every year since their introduction, but not with any regularity, and as a whole these nets may be said to have cut a small figure in connection with the fisheries of that region. This has been especially so since the rapid increase in the number and efficiency of the traps began. In 1893 and 1894, when three or four were in use, they did very well, and in the latter year a good proportion of the cannery supplies at Point Roberts were so obtained. In 1895, however, the catch by this means was reported very small, as the traps furnished sufficient quantities of sockeye from day to day to supply the canneries and no silver salmon were canned.

The total number of purse seines reported for the Puget Sound region in 1897 was 46, and in 1898 it was 40.

DRAG SEINES.

Although drag seines were sometimes employed on a small scale in connection with the early fishery of the Fraser River district, they have been entirely prohibited for a considerable period throughout British Columbia, except in certain localities outside the region under discussion, where the water is too clear for gill-netting. In Washington they seem to have been the earliest form of net introduced by the whites, and they are still widely used, though not very extensively in any one place. Their first employment to any extent was apparently at Point Roberts, where the traps have virtually superseded them. They were there hauled mainly around the southwest corner of the point, and thence up along the west side to a distance of 1½ miles, the shore elsewhere being generally unsuited for the purpose. When rounding the southwest corner a part of the salmon keep well in to the shore, yet large catches of sockeye were never made there, and if 300 or 400 fish were captured at a haul it was considered a fair result. In the early fall, however, the silver salmon would be taken in greater numbers. As the traps multiplied and were made effective the seines gradually went out of use, though they may still be employed occasionally.

The most important recent drag-seine fishery seems to be that which has now been carried on for a number of years to obtain salmon for canning purposes at Seattle. Eight nets, measuring from 200 to 600 feet long and with a 3-inch mesh, were in use in that connection in 1895. Near the mouth of the Skagit River 6 seines were operated in 1894, 2 by the whites and 4 by the Indians. The former were about 600 feet long by 30 feet deep; the latter 180 feet long by 10 feet deep, both having a 3-inch mesh. Seining is also done in the neighborhood of Utsalady, in Skagit Bay, and in both of these localities relatively large catches are said to be made. Good seining grounds are reported in the vicinity of the mouth of the Nooksack River, though they had not been much resorted to up to 1895.

Small seines are employed to some extent for salmon, by both whites and Indians, at several places along the south shore of the Strait of Juan de Fuca, chiefly in Discovery Bay and about Dungeness and Point Angeles. Nearly all the catch is consumed locally, but small quantities may be carried to market as far east as Port Townsend. The species principally obtained are humpbacks and silver salmon. The cannery established at Port Angeles in 1895 had 12 seines in use in that vicinity the same year.

Small seines will undoubtedly be found elsewhere in nearly all places along the Washington shore where settlements exist, and where the conditions are suitable for taking salmon by this method. This form of net is one of the most convenient to operate and affords a ready means for securing food.

The total number of seines employed in the Puget Sound region in both 1897 and 1898 was placed at 59.

REEF NETS.

The reef net is the exclusive property of the Indians, by whom it has long been used. Its name is derived from the character of sea bottom for which it is specially adapted—the peculiar kelp-covered reefs—but while such abound throughout the region, the number over which the sockeye pass in sufficient quantity to furnish good fishing seems to be comparatively small. Formerly the nets were made from the fiber of cedar bark or roots, the preparation of which was a winter occupation and consumed much time. Cotton twine is now used and since its introduction the nets have been enlarged. They consist of a piece of webbing, which varies more or less in size, but may average perhaps from 36 to 40 feet long by 25 to 30 feet across, the mesh being about 3½ inches.

To prepare for fishing a channel of suitable width is cut through the kelp, and in this the net is set between two canoes so anchored from both ends as to keep them parallel with and at the sides of the passageway. The suspension of the net is accomplished by means of guy lines leading from the canoes and head anchors. In the position which it then assumes the front end, facing the current, sinks near the bottom, while the hind end curves to near the surface. Although the kelp may be quite submerged along the sides of the channel, still it tends to direct the fish toward the net, and their movements may still further be controlled by short leads of kelp run out from the front corners of the latter. In case the depth of water is too great, ropes are sometimes stretched across the channel below the front margin of the net, and to these bunches of reeds may be attached with the object of turning the fish upward.

The salmon, approaching with the current, pass upon the net. They do not mesh, nor is there anything to prevent their escaping at the sides. It is at this point that the Indians are required to display their skill. An experienced man stands in the bow of each canoe as a lookout, while each of the guy lines is in the hands of a member of the crew. The moment fish are seen coming over the net word is given to haul in, a command which must be promptly obeyed. The side lines leading to the stern anchors are tripped at the same time, causing the boats to come together, so that the net can be gathered up from all sides in a sort of bag. The contents are emptied into the canoes, the net is again thrown over and spread out, and the watching resumed. Success depends upon the net being hauled quickly and properly at the right moment. Should the fish have turned before the first step is taken, they are likely to escape wholly or in greater part. Constant vigilance is required, but the Indians have become so expert that they seldom fail to land their catch, and their success seems to depend only on the appearance of the fish in sufficient quantity.

When the fish are running well a large reef-net crew will consist of 10 to 15 Indians, as at Point Roberts, but in some places the nets are smaller and the crew may not contain more than 6 to 8 men. On Cannery Point Reef it is said that under exceptionally favorable conditions a haul can be made every 2 or 3 minutes, and a single large catch may fill the two canoes. With fishing at its best a single net may secure as many as 2,000 salmon in a day, but to do this the fishing canoes must continue at their posts, the catch being transferred to shore by other boats. In 1894 and 1895, however, scarcely anything was accomplished with the reef nets in this locality.

The proper time for fishing with these nets is during the set of both the ebb and flood tide, when the current is running not swifter than 5 knots an hour. They can only be used in clear water, as it is essential that the salmon should be plainly seen; when the water is muddy or the surface rough nothing can be done. While originally the Indians employed this method only for a short period each season to supply their own wants, in recent years they have found a ready sale for their entire catch, which, consisting as it does mainly of sockeye, is in great demand at the canneries. The money value of this species is now so great that they retain only small quantities at the most for drying. Reef-net fishing could not, however, be profitably followed by the whites, owing to the number of hands required to operate the net and the great loss of time resulting from unfavorable conditions of sea and weather. The Indian reef-netters belong partly to the Lummi Reservation and partly to British Columbia. The latter fish chiefly about the San Juan Islands, coming over specially for that purpose.

What is probably the largest and has been the most productive ground in the region for this kind of fishing is the reef directly south of Cannery Point, at Point Roberts, which has been described in another connection. From 15 to 20 nets were formerly fished here at a time, and with much success; 16 were in operation in 1889, but in 1894 the access of salmon to the reef had been so cut off by strings of trap nets as practically to destroy its advantages, although the Indians still visit it. Each crew had formerly two places to fish upon, one for high and one for low water, in order to extend the hours of work, it being considered preferable that the water should not exceed 8 feet in depth at the time of fishing.

Between Village Point and Bluff Point, on the outer side of Lummi Island, there is also an excellent ground, with capacity for about 6 or 7 reef nets, which is resorted to by the Indians from the neighboring reservation. Salmon have been abundant here and large catches have been made, but, as at Cannery Point, trap nets have recently been so placed as to divert a large proportion of the fish from the reef and reduce its value for the purposes of the Indians.

There is a small but productive reef inside of Iceberg Point, at the southern end of Lopez Island, on which a few nets are used, and where daily catches of 3,000 to 4,000 salmon are sometimes made. Both sockeye and silver salmon are taken at this place, the former at least being now mostly sold to the cannery at Friday Harbor, and in good seasons the reef is an important source of supply. The nets are sometimes set in an extreme depth of 18 fathoms. We were told by some of the Indians fishing here that although they have tried for quinnat they have never been successful with that species, probably because it does not appear in defined schools. Humpbacks and dog salmon occur abundantly, but are not fished for, as they have no sale. There seem to be no other reef-net grounds about Lopez Island, but several small ones are fished off the west side of San Juan Island and off both the east and west sides of Stuart Island. Others probably exist, of which we obtained no definite information.

HOOK-AND-LINE FISHING.

The quinnat and silver salmon are the only species which will take bait and can be fished for with a hook. The fishery by this means, trolling with bait or spoon, is insignificant compared with the net fishery, but it affords the opportunity for securing especially the quinnat in the winter and spring when nets can not be used profitably if at all. The catch so made is disposed of to the fresh markets or utilized for domestic purposes by the fishermen. Both Indians and whites engage in it, the former most extensively. Some of the more prominent localities for this fishery are off Victoria and Port Townsend, about the San Juan Islands, off Nanaimo, and off Point Roberts, and in some places it is indulged in for sport as well as for securing food.

Sport fishing for salmon with fly and spoon is carried on to a limited extent in some of the smaller clear rivers, especially in British Columbia. The quinnat is said to be the only species which can be so taken, and the fishing-places are the pools in which they rest during their journey upstream. Trout are also very abundant in such localities and are obtained by the same means. The Indians about Neah Bay do a great deal of trolling for salmon to supply their own wants, the fishes of this group following next after the halibut in importance as an article of food among them. The fishing season there is chiefly the months of June, July, and August. Details regarding the hook-and-line fishery have already been given under the headings of the quinnat and silver salmon.

SPEARS.

Spears seem to be used rather extensively, in the clear, shallow upper waters of many of the rivers, for obtaining salmon as they approach their spawning-grounds. The fish so taken are, naturally, not in the best condition for food, nor are they sought by this means for commercial purposes, unless it be to supply a local demand. The Indians follow this method most, but white settlers also employ it where they have the opportunity to do so, and often in this way add greatly to their stock of food. In some localities the catch must be relatively rather large, as is known to be the case in the upper waters of the Skagit River. Besides the ordinary form of spear, a gaff is also frequently employed, the handle to either one being sometimes made of extra length to permit of its being used from the banks of a stream. Under favorable circumstances it is said to be possible to select from the fish, as they pass by, the particular species that is most desired or the more robust and healthy individuals.

DISPOSITION OF THE SALMON CATCH.

Until quite recently this region has occupied, from the standpoint of trade, a position of comparative isolation which the completion of railroads has only partly overcome, owing to its distance from large consuming centers. In the development of the salmon fishery and the disposition of the catch it has, therefore, been necessary to resort to methods of preparation which would insure the preservation of the product for indefinite periods. Salting naturally came first, followed by canning, while now the shipping of fresh salmon is a rapidly growing business.

The salting process was introduced at the beginning of the century by the Northwest Company and afterwards continued by the Hudson Bay Company, primarily for the purpose of providing a winter stock for the use of their employees and for local sale. As the facilities for shipping opened up, an export trade began, which finally reached large proportions and has long constituted an important feature of the salmon industry on both sides of the boundary line. Requiring little outfit, this branch has been engaged in by men of small means as well as by establishments having considerable capital. While both the quinnat and sockeye are utilized in this way, the greater part of the output consists of the cheaper grades of salmon. The product is mostly disposed of to the eastern United States and to Australia, the Hawaiian Islands, China, and Japan.

The smoking of salmon was also begun in British Columbia at an early date and was subsequently taken up in Washington, but the quantity prepared in this way has always been small.

Canning presented a somewhat more refined method of preparation, the product of which soon gained great and world-wide popularity. The growth of this particular branch of the fishery was quite rapid from the beginning, and during the past few years has been remarkable. Its limitations are measurable only by the supply of fish and the restrictions of trade.

The utilization of the salmon from this region in a fresh condition, except locally, was long delayed, owing to the lack of transportation facilities to large markets, of which there are none in proximity to the Pacific coast. The preference for fresh fish, however, led to the early utilization of through railroad communication to place the western species in competition with their Atlantic congener in the very home of the latter. This trade is now having a marvelous development. It reaches the larger cities along the Atlantic seaboard and in the interior of the country, and has recently found an outlet in Europe and other parts of the world. Shipments have chiefly been made during winter and spring when the salmon are in best condition and the weather is most propitious. Ice is used in packing to the extent made necessary by temperature and other conditions, and freezing methods have recently been introduced.

The quinnat is preferred for the fresh trade, and in the spring, before the Atlantic salmon are in season, it commands so high a price as to make its purchase for canning purposes unwarranted. The steelhead is also a fresh-market fish and is sold almost exclusively as such, it being obtained most abundantly in the best condition during the winter, when the fewest difficulties attend its shipment. The sockeye and other species are likewise utilized in this trade, but the latter least extensively on account of their lighter color.

The most important centers for the shipping of fresh salmon are New Westminster, in British Columbia, and Seattle, in Washington, but small quantities may be sent inland directly from a few other places, more especially from Tacoma. The bulk of the fish intended for this trade, however, is forwarded to one or the other of these cities from fishing-grounds or from collecting places on steamer routes. Thus Seattle may derive its supplies of quinnat from the Strait of Juan de Fuca by way of Port Townsend, from the San Juan Islands through the several stopping-places which the steamers have in that group, from Skagit Bay and River, and so on, the entire field tributary to Seattle being an extensive one. The New Westminster supplies come partly from the Gulf of Georgia, but mainly from the Fraser River.

The freezing of salmon seems to have been started on the Fraser River as early as 1886, but not much was apparently done in that line until within a few years. There are now several freezing establishments in British Columbia and Washington, and the business outlook is exceedingly promising. By this method not only may a large stock of fish be laid in when the season serves best, to be disposed of as demands arise, but a way is opened to new and more distant markets. The prospects are for a large and profitable trade which shall greatly increase the fishing industry of the region.

The local trade in salmon is relatively large in comparison with the extent of population, the low price at which they can generally be obtained, especially the least desirable commercial forms, placing them within the reach of all. Many of the inhabitants fish for their own table, using nets and spears in the rivers and the trolling hook in salt water. The Indians have always depended very largely on the salmon, one of their chief occupations having been the preparation of a large winter stock by drying. In some places, where they have come much in contact with the whites and are receiving pay for their labor or catch, this custom is not so strictly followed, if at all, but the total Indian consumption in British Columbia is estimated in the official statistics at a very high figure.

CANNERIES.

In that part of British Columbia here under consideration the canning industry seems always to have been confined to the Fraser River, for the reasons undoubtedly that it is the only place where the sockeye can be taken abundantly and where the other species of salmon may also be captured more readily than elsewhere. The first cannery on the Fraser was apparently built at Brownsville, opposite New Westminster, about 1870 or 1871. It was removed to New Westminster in 1873 and one or more small ones in addition are said to have been in operation the same year, when the total output of canned goods was reported at about 390,000 pounds. The regular series of statistics for the British Columbian coast date from 1876, when there were 3 canneries with a total pack of 511,056 pounds. In 1883 the number had increased to 12, but it fell off the following year to 6, and was the same in 1885. Since then, however, there has been a steady and rapid increase, their number amounting to 31 in 1895 and to 45 in 1898.

Changes have taken place in the location of the canneries, which are interesting to note. The industry was formerly carried on more extensively in the upper part of the drift-net region, there having been at one time as many as 4 canneries in the neighborhood of New Westminster, where now there is only 1. The center of the canning business has worked down the river, as the fishing has been carried more and more in that direction. Ladner and Canoe Pass became the centers for a time, but it has now been transferred to Steveston, at the main entrance to the river, where in 1895 about one-half the total number of canneries was located. This place is now most centrally situated with regard to the more productive fisheries, having on one side those of the outer grounds and on the other those in the lower part of the river. In 1895 there were only 6 canneries above the village of Ladner, 15 at Steveston, the remainder being on the south bank from Ladner to Canoe Pass. The number of canneries on the Fraser River, together with the pack in each year since the beginning of the industry, is given in the statistical table for British Columbia.

Outside of the Fraser River the principal cannery sites in British Columbia are on the Skeena River, where the business was started as early as 1875, and on the Naas River. There has been a small cannery at Alert Bay since 1880, drawing its supplies of sockeye from the Nimkish River, which empties on the adjacent coast of Vancouver Island, and 2 are located on Clayoquot Sound, western coast of Vancouver Island, one established in 1895, the other in 1896. Except during three years when the sockeye runs were very small, the Fraser River pack has exceeded, and generally very greatly, the combined pack of all the other canneries of the Province.

The greater part of the canned salmon produced in British Columbia has always been exported to England, being shipped by vessel, generally in large lots. The remainder is divided between Australia, other foreign markets, and the Canadian trade.

The canning industry is of more recent date in the Puget Sound region of Washington than in British Columbia, and is still less extensive, although during the past few years its growth has been very rapid. Not having the same river facilities as British Columbia, it is necessary to look more to the salt waters for its supplies, and in the matter of obtaining sockeye, the species most cherished for canning purposes, its advantages are considered not so good. It would thus appear as though Washington could never expect to produce as large a pack of the higher-priced fish as the Fraser River is capable of supplying, though it may prove otherwise, but of the inferior species Washington has sufficient abundance to permit as great an expansion of the business as the demands of trade are likely to warrant for some years to come.

In 1895 there were only 6 canneries in operation on the Washington side of the line. The oldest establishment was started at Muckilteo in 1877, removed to Port Blakely about 1880, and subsequently to Seattle, where it is now located. The species put up are silver, humpback, and dog salmon, together with a few quinnat when they can be obtained. In 1880, 15 hands were employed and the pack amounted to 10,000 cases, while in 1895 the pack reached 81,177 cases. At one time there were 4 canneries in the neighborhood of Seattle, but 3 of these are no longer in operation, although a new one was established there in 1897. The next oldest cannery still in existence is the one established in 1891 at Semiahmoo, at the eastern end of Boundary Bay, which, beginning with 1894, has been run in conjunction with the one built at Point Roberts in 1893. Both draw their supplies from the trap nets about that point, the most of which they control, and also, to some extent, at times from other nets in Boundary Bay. These 2 canneries, therefore, under present conditions are the most advantageously placed of all the canneries south of the boundary with regard to obtaining supplies of sockeye, and their attention is almost entirely confined to this species except in seasons when the run proves short. Some silver salmon, humpback, dog salmon, and quinnat have been put up at both of them.

A good-sized cannery was founded in 1894 at Friday Harbor, on the eastern side of San Juan Island, which is a convenient center for securing sockeye from the various fisheries about the San Juan group. Its supplies up to 1896 had been obtained chiefly by means of traps at the southern end of San Juan Island and from the Indian reef-netters, but apparently it has been found impossible to rely entirely upon the catch of that species. In 1895 a cannery was built at Port Angeles, with the expectation that a sufficient quantity of sockeye for its own use could be obtained in the Strait of Fuca, but all efforts to that end have met with failure, and it has been obliged to look elsewhere for its stock of that species. Some years ago a similar experiment was tried at Clallam, but it was soon abandoned. The sixth cannery examined in 1895 was an experimental one of small size in Bellingham Bay, which expected to obtain its catch in the vicinity of the mouth of the Nooksack River.

There were 11 canneries in operation in 1896; 12 in 1897, and 18 in 1898. The new ones were located mainly at Blaine, on Lummi Island, in Bellingham Bay, at Anacortes in Skagit Bay, and at Seattle. At Anacortes there were 3 canneries, all established in 1896, with the object of taking advantage of the run of sockeye belonging to the Skagit River. The pack in 1897 was exceedingly large, and to a very great extent consisted of sockeye, of which the run in that year, as elsewhere explained, seems to have been unprecedented.

On the Fraser River the canning season is practically coincident with the period of the sockeye run. A few canneries may start up in June in order to do something with the quinnat, and in those years when the supply of sockeye is inadequate for a full pack some establishments may continue operations during more or less of the silver salmon run. In Washington also little or nothing is done before the appearance of the sockeye, and while most of the canneries there would be satisfied to close with that species, could they obtain it in sufficient quantity, nearly all have been more dependent on other species than the Canadian canneries and are more likely to keep open later. The Seattle canneries, whose supplies are obtained outside the sockeye region, begin operations much later than the more northern canneries and continue them during the greater part of the fall.

While the positions of trust in the several canneries are chiefly filled by whites, nearly all the labor, both in British Columbia and in Washington, is performed by Chinese, who become exceedingly expert in every branch of the business and work rapidly. The secret of their employment to so great an extent is the cheap rates of compensation with which they are satisfied—a condition which practically excludes white labor, but without which it is difficult to see how the canning industry could now be maintained. It would, moreover, be impossible, under existing circumstances, to secure the amount of white labor required in the large canning districts, in view of the temporary nature of the work. In some of the canneries, especially on the Fraser River, Indian women and children are employed to clean the fish after they have been eviscerated, being members, generally, of the families of the fishermen who are operating in the same neighborhood.

It is important to note in this connection the amount of waste which occurs in the preparation of salmon for canning. In cutting off the heads, tails, and fins sufficient care is not always exercised, and much flesh suitable for canning too often goes with the refuse. This improvidence is largely owing to the abundance of fish, and it is scarcely to be expected that a remedy for it can be found while the supplies continue so prolific. The total loss in weight to the fish during this process, including the removal of the entrails, ranges from 25 to 50 per cent, and is probably seldom less than 30 to 40 per cent. The greater part of the waste is of course unavoidable, and the most that can be hoped for in this regard is that some use will soon be found for it.

FISHERMEN'S PRICES.

The prices which the fishermen receive for their catch depend upon the species and fluctuate in accordance with the supply and demand. They vary markedly in different parts of the same season as well as in different years. The matter is mostly regulated by the canneries during the period when they are in operation. When the quinnat first begin running on the Fraser River in the spring and are in greatest demand for the Eastern trade they may bring as much as from $1 to $1.25 apiece, but the price soon falls, reaching 75 cents and even less. The highest price which the British Columbian drift-netters obtain for sockeye is about 25 cents each, but this figure prevails only at the beginning of a season or during one in which the catch is small and causes a sharp competition among buyers. As the season advances and the fish become more abundant it may fall off to any figure as low as 15 and even 10 cents, while during summers when extraordinary runs occur 6 or 7 cents may be as much as a fisherman can expect to receive, and even then not all of his fish may be wanted. In 1897 many were glad to get as high as 3 cents, and a large part of the catch was refused at any price. The customary range in price, however, is from 15 to 25 cents.

At Point Roberts it is said that, except when sockeye are scarce, the cost of their capture by trap nets is much lower than the prices paid on the Fraser River, and it is probably the same elsewhere when fish are abundant. In this way the Washington canneries which obtain their supplies from this source are considered to have a marked advantage over the Canadian. The sockeye taken in the reef nets at Point Roberts, Lummi Island, and the southern end of the San Juan Islands were bringing 10 and 15 cents apiece in 1894 and 1895, but the Indians are often paid no more than 5 to 8 cents for them.

From 5 to 8 cents is a common price for silver salmon, while dog salmon range from 2 to 6 cents apiece. During the winter the steelhead bring about 3 to 4 cents a pound for the fresh markets.

POLLUTIONS AND REFUSE.

There seem at present to be no sources of pollution in this region which can be considered as positively detrimental to the fisheries in the salt water, and the same also appears to be mainly true as regards the rivers, except as to some localities of limited extent. This may be accounted for in greater part by the scarcity of large settlements and the generally low temperature of the water.

Sawmills have been built on many of the rivers, on some of them quite extensively, and the large amount of refuse which they produce may, unless suitably cared for, be the cause of great and irreparable injury, as has been so strikingly illustrated on the rivers along the Atlantic coast. On the Fraser River the number of mills is not great, and the laws regarding the proper disposition of the sawdust are said to be quite generally observed. In Washington, while the throwing of sawdust into the streams is prohibited, it is reported that the regulations had not been well enforced, although some change may recently have taken place in that respect. Attention has been especially called to the Skagit River, on whose banks there are numerous shingle mills, from which a very large amount of refuse is allowed to enter the water. According to the statements from the fishermen in that region, this practice has caused a great deal of damage to the spawning-grounds of the salmon and has affected the fishery in other ways.

The proper disposition of the offal produced in connection with canning operations presents a problem of very great importance for this region, especially as regards the Fraser River, where the industry is most extensive. The refuse from this source, consisting of the heads, fins, tails, and entrails, has as yet no market value and must be quickly disposed of. Its quantity is very great, equaling at the lowest calculation more than one-fourth the total weight of the fish utilized, and at this rate amounting to from 650 to 3,800 tons annually on the Fraser River alone. In many cases it runs up to 40 and even 50 per cent. When it is further considered that the season lasts only from four to six weeks, and that the bulk of the fish comes in spurts, lasting only a few days each, the difficulties of the situation can be fully realized. The generally prevalent custom is to allow the refuse in its fresh condition to drop into the water underneath or alongside of the cannery. As the water of this region, both at sea and in the rivers, has a relatively low temperature at all times, this practice is less open to objection than would be the case in a warmer climate.

The Washington canneries are all located on the salt water in more or less exposed positions, where the tide generally runs strongly and the depth increases rapidly. The greater part of the refuse disappears at once and is never heard of, although in some places a certain proportion may be washed upon the shores. There is no reason to believe that it has anywhere been detrimental to the fishing interests, and in view of the sparsely settled condition of the coast in the vicinity of nearly all the canneries there seems to be little occasion for concern from a sanitary standpoint. The number of canneries must also for some time remain too few to make the disposition of their refuse a question to be handled by other than the local authorities.

On the Fraser River the matter is more serious, as nearly all the canneries are located within a distance of 6 to 8 miles of the mouth of the river; yet even here there is no evidence that the offal has had any deleterious effect upon the run of salmon. That injury of that character is scarcely to be expected from this cause is indicated, moreover, by the still worse conditions produced each season about and immediately below the spawning-grounds by the floating masses of dead and decaying fishes through which the fresh arrivals continue their ascent, in no way checked by the foulness of the water. The pollution in those places is strikingly in evidence, while in the region of the canneries there is generally little to be seen. The large volume of water in the lower part of the river, combined with the strong current and low temperature, tends to dissipate the offal, which mainly disappears as completely as in the sea. It is a common local belief that much of it is consumed by the small fishes which are reported to swarm about the cannery sites, but it is doubtful if they exert any appreciable influence in disposing of this immense amount of refuse. Sometimes, it is said, the offal is stirred up by the eddies so as to become caught in the drift nets when they are fished in shallow water, but such occurrences are evidently quite infrequent.

From a sanitary point of view, however, the offal has proved a nuisance in some localities. This is not so at New Westminster, where no trouble from this source has been reported. The uppermost point at which complaint was made is Ladner, and the conditions are also often bad in the neighborhood of Steveston. In this region the offal is sometimes stranded by the current or retained by the eddies, so that when the tide is out it may become exposed on the bars and in places along the banks, emitting an exceedingly offensive odor. It is also drifted into some of the sloughs, and may thus be carried some distance inland, greatly to the annoyance of the farmers, who have often to depend upon the water from these places for domestic use. The local authorities at Ladner have been making strenuous efforts to abate the nuisance on the score of injury to the public health[illegible] at last accounts they had not been entirely successful.

Several expedients have been [illegible] obviate the trouble caused by the cannery refuse, but all have [illegible] without definite result. The Canadian law forbids throwing it[illegible] river, but as the enforcement of the regulation under existing circumstances seems to work injustice to the canneries, its operation has generally been suspended, with the expectation that some advantageous method of disposing of the offal would sooner or later be discovered. It was at one time insisted that unless disposed of for fertilizing purposes it be buried on shore, be carried out and dumped in the Gulf of Georgia, or be confined in cribs underneath the canneries; but none of these provisions continued long in force. When held in cribs a nuisance was created by the oily matter running from the mass of decaying fish, and the inclosures would often break open, allowing a part of their contents to escape. If retained in cribs or in scows, even for a short time, the refuse was rendered largely buoyant by the formation of gases in the putrid flesh, so that when deposited in the gulf much of it remained floating at the surface, and with a flood tide and westerly wind would be drifted on the shore or even into the river mouth. The outside dumping-ground has now become one of the most important of the drift-net areas, and the inexpediency of continuing its use for the former purpose is fully recognized. Could the refuse have been carried farther out into the middle of the gulf this trouble would have been mostly prevented, but at a greatly increased cost.

Several attempts have been made to utilize the offal by converting it into fertilizer on a commercial basis, but as yet unsuccessfully. Its very oily nature makes the process difficult and expensive, and another serious trouble arises from the immense quantity required to be handled during the brief period of the fishery, necessitating extensive arrangements, the cost of which would scarcely be warranted by the shortness of the season.

While the offal is fresh it sinks at once and gives no trouble, except under the circumstances previously described. Until some positively better plan has been discovered, this seems, therefore, to be unquestionably the preferable way of disposing of it, provided certain precautions are observed. It should be allowed to go into the river only where the water is sufficiently deep and the current strong enough to cause its dissipation. If these conditions do not exist at certain of the cannery sites, then the offal there produced should be carried elsewhere for deposition. A study of the conditions is called for in all localities where canneries are in operation, and the gravity of the question presented by this subject warrants extreme measures to preserve the cleanliness of the river for the sake of the general health and appearances. As regards the salmon, however, the continuance of their runs seems to be in no danger from any of the circumstances connected with the offal problem. [illegible] fact that fresh offal sinks to the bottom gives color to the comp[illegible]ade in some other regions where bottom fisheries are carried o[illegible]h the salmon, which keep above the bottom and are supposed [illegible] influenced in their passage by the conditions it displays, th[illegible]ry different.

REGULATIONS AFFECTING THE SALMON FISHERY.

WASHINGTON.

The laws of 1890 and 1893, which were in force at the time of the investigation by Dr. Wakeham and the writer in 1895, contained a few excellent measures, but their application being limited by a decision of the court to Puget Sound in its restricted sense, the more northern waters of the State were practically left without regulations. It is understood that this unfortunate condition has been remedied, and subsequent acts of the State legislature, passed in 1897 and in 1899, have introduced many very stringent and commendable regulations regarding the manner of fishing and the localities where the different methods may be used. There is still lacking, however, an adequate close-season law. The latest regulations did not come to the attention of the writer until after the completion of this paper, a fact which will serve to explain the omission of fuller reference to them in the appropriate places. The measures now in force relating specially to the preservation of the salmon in the Puget Sound region are briefly summarized below, the year in which each act was passed being also given:

All that part of tide waters emptying into the Strait of Fuca, and the bays, inlets, streams, and estuaries thereof, shall be known and designated as Puget Sound. (1890.)

The use of pound nets, traps, weirs, fish wheels, and other fixed appliances, purse nets, drag and other seines, set and drift gill nets is permitted in the waters of Puget Sound and its tributaries as provided below. (1897.)

All fishing by nets and fixed appliances is subject to license, a separate license being required for each piece of apparatus. Licenses are issued only to citizens of the United States who are residents of Washington. Each person, firm, or corporation is entitled to only three licenses. (1897.)

The use of pound nets, traps, weirs, fish wheels, and other fixed appliances, except set lines, for the purpose of catching salmon, is prohibited in all rivers flowing into Puget Sound and outside of said rivers within 3 miles of their mouths; also in Deception Pass or within one-half mile of its western entrance, and in any other salt waters of the State at a greater depth than 65 feet at low tide. (1897.)

It is unlawful to use any purse net or other like seine within 3 miles and drag seine within 1 mile from the mouth of any river flowing into Puget Sound or within said rivers. (1899.)

No seine location the title to which is in the State shall occupy a greater space than twice the length of the seine covered by the license. (1899.)

No lead of any pound net, trap, fish wheel, or other fixed appliance for the catching of salmon in Puget Sound shall exceed 2,500 feet in length. There shall be an end passageway of at least 600 feet and a lateral passageway of at least 2,400 feet between all pound nets, traps, weirs, or other fixed appliances. (1897.)

Between all set gill nets there shall be a lateral passageway of at least 300 feet and an end passageway of 30 feet. (1899.)

No fishing appliance or device of any kind located or used upon any streams or rivers shall, either by a lead or any parts of said appliance, occupy more than one-third the width of such streams or rivers. (1899.)

The meshes in all pound nets, traps, weirs, fish wheels, or other fixed appliances for the capture of salmon shall measure not less than 3 inches in extension. (1897.)

It is unlawful to take or fish for salmon by any means except angling above tide water in any of the following rivers: Nooksack, Skagit (up to the town of Hamilton), Stillaguamish, Snohomish, White, Nesqually, and Skokomish. (1899.)

Whenever the Fish Commissioner shall consider that the protection of the food-fishes mentioned in this act (March 13, 1899) shall require it, he may close to fishing any stream or river in this State emptying into Puget Sound, etc. (1899.)

All dams or other obstructions in streams where food-fish are wont to ascend shall be provided with fishways approved by the Fish Commissioner, and it is unlawful to take any food-fish within 100 yards of any such fishway. (1893.)

Throwing into the water any substance deleterious to fish, including the waste from sawmills, and the use of explosives for killing fish are prohibited. (1890, 1891.)

It is unlawful to take salmon in any of the tributaries of Puget Sound during April and from October 15 to November 15 in each year. (1899.)

All young salmon measuring 10 inches long or less which may be taken by any means except hook and line in either Puget Sound or any of its tributaries shall be returned alive to the water. (1893.)

Indians residing in the State may take salmon or other fish by any means at any time for the use of themselves and their families. (1899.)

All moneys collected for licenses and fines under provisions of the fisheries acts shall be turned into the State treasury and placed in the fish-hatchery fund. (1897.)

BRITISH COLUMBIA.

Following is an abstract of the more essential regulations regarding salmon fishing in the Fraser River district, which went into effect May 1, 1894, together with such amendments as have since been ordered:

Commercial fishing is restricted to the use of drift gill nets not exceeding 150 fathoms in length, and to tidal waters, the upper limit of which on the Fraser River is placed at the mouth of the Sumas River.

The drift nets for quinnat salmon shall have not less than 7¼-inch mesh, and can be used only from March 1 to September 15. (By order of June 19, 1897, the limitation upon the size of the mesh of the quinnat nets was reduced to 7 inches, mainly with the object of adjusting them to the capture of the steelhead and silver salmon.)

The drift nets for other kinds of salmon shall have not less than 5¾-inch mesh, and can be used only from July 1 to August 25, and again from September 25 to October 31.

All commercial fishing for salmon is prohibited weekly from 6 a. m. Saturday to 6 p. m. Sunday, and annually from September 16 to 25, and from November 1 to March 1.

Drift nets shall be kept at least 250 yards apart, and shall not be used so as to obstruct more than one-third the width of the river.

Above tidal waters the only net fishing permitted is the use of dip nets by the Indians to provide food for themselves and their families. The Indians, however, are required to respect the spawning-grounds of salmon and the close seasons.

Fishing can be carried on only under license, except in the case of Indians fishing to supply their own wants.

Commercial licenses to fish for salmon are granted only to *bona fide* fishermen who are British subjects and residents of British Columbia, or to any company, firm, or person dealing in salmon when each member of such company or firm or such person is a British subject.

Fishermen are entitled to 1 license each; dealers in fresh, frozen, salted, cured, or smoked salmon for domestic or foreign trade are entitled to 7 licenses each; canneries are entitled to 20 licenses each. (Canneries were restricted to 10 licenses each by orders of August 3, 1898, and March 29, 1899.)

Every farmer or settler actually residing on his lands or with his family, being a British subject, is entitled to 1 "domestic" license, which gives him the privilege of fishing for his own use in any of the waters of British Columbia, subject to certain restrictions as to nets, prescribed limits, spawning-grounds, and close seasons.

The capture and retention of any salmon under 3 pounds in weight is prohibited.

The use of firearms, explosives, spears, torches, or other lights to kill fish is prohibited.

No deleterious substances are allowed to be thrown into or to enter the water where they would be prejudicial to the fisheries. Under this category is included fish offal, the throwing of which into the Fraser River is prohibited by regulation. Its disposal is provided for in the Fisheries Act as follows: That it may be buried ashore beyond high-water mark, and that at establishments situated inside of the mouths of rivers for carrying on deep-sea fisheries the same may be dropped into perforated boxes or inclosures built upon the beach or under stage heads, in such manner as to prevent the same from being floated or drifted into the stream, or may be disposed of in such other manner as any fishery officer prescribes.

Fishways shall be provided at every dam, slide, or other obstruction across or in any stream where the Minister of Marine and Fisheries determines it to be necessary for the public interest.

STATISTICS.

Salmon catch of the Puget Sound district of the State of Washington.

[Compiled from the reports of the United States Fish Commission and the State Fish Commissioner of Washington.]

Years.	Quinnat.	Sockeye.	Silver.	Humpback.	Dog.	Steelhead.	Total.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1888	....	....	....	....	....	....	2,038,250
1889	96,228	....	1,388,495	283,042	366,117	90,570	2,224,452
1890	132,183	....	1,093,822	....	854,973	172,460	2,253,438
1891	202,675	522,700	1,414,010	715,061	905,911	269,380	4,029,737
1892	285,748	274,225	1,836,904	....	2,691,425	261,142	5,349,444
1895	1,405,047	6,532,207	9,100,675	2,269,766	4,578,540	1,965,552	25,851,787
1896	....	....	....	....	....	....	*15,000,000
1897	....	....	....	....	....	....	42,725,000
1898	....	....	....	....	....	....	32,213,000

NOTE.—The figures for 1896, 1897, and 1898 are based upon the returns given in the reports of the State fish commissioner, and are only approximate. Those for 1896 are probably in error, being evidently too low.

Salmon cannery pack of the Puget Sound district of the State of Washington.

[Compiled from the reports of the United States Fish Commission and the State Fish Commissioner of Washington.]

Years.	No. of canneries.	Quinnat.	Sockeye.	Silver.	Humpback.	Dog.	Total.
		Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
1889	2	15,648	....	486,192	182,592	74,448	758,880
1890	1	3,984	....	238,944	....	200,112	443,040
1891	1	24,816	360,000	381,504	367,056	201,024	1,334,400
1892	2	5,616	192,000	489,984	....	1,051,728	1,739,328
1893	3	57,600	2,296,896	566,976	841,440	546,240	4,309,152
1894	4	....	2,005,488	1,076,064	*434,352	1,063,296	4,579,200
1895	5	74,016	2,126,864	2,441,520	1,124,384	1,861,680	7,628,464
1896	11	647,760	2,502,992	3,966,720	....	1,274,400	8,391,872
1897	12	456,000	14,978,304	4,411,200	2,748,864	1,118,880	23,713,248
1898	18	537,600	12,096,000	4,732,800	....	1,843,200	19,209,600

*These figures are given in the tables of the United States Fish Commission (Report for 1896, p. 581), although no humpback salmon could have been taken that year.

Statistics of the British Columbia salmon fishery of the Fraser River, Gulf of Georgia, and Strait of Juan de Fuca.

[Compiled from the annual reports of the Department of Marine and Fisheries of Canada.]

Year.	No. of drift-net licenses.	Total length of drift nets.	No. of canneries.	Output of canned salmon.	Quantity of salmon sold fresh, salted, and smoked.	Total salmon catch.
		Yards.		*Pounds.*	*Pounds.*	*Pounds.*
1876			3	511,056	96,200	777,608
1877	265	44,040	5	3,090,576	690,200	4,810,968
1878	440	114,580	8	5,044,880	1,010,200	7,736,707
1879	304	65,600	7	2,423,520	157,300	3,388,660
1880	274	105,240	7	2,023,440	413,580	3,111,500
1881	396	134,400	8	6,840,768	2,306,200	11,427,224
1882	696	205,600	13	9,561,972	878,200	13,627,496
1883	764	215,780	12	5,266,098	1,170,000	8,191,464
1884	702	21[illegible],770	6	1,844,976	1,720,560	4,180,528
1885	655	189,200	6	4,301,016	2,396,400	8,131,088
1886	734	282,920	11	4,758,576	842,350	7,187,118
1887	935	250,850	12	6,182,688	1,954,600	10,198,184
1888		282,520	12	3,677,568	2,375,400	7,278,824
1889		254,200	16	14,789,856	2,620,700	22,340,508
1890		298,880	17	11,742,600	1,898,100	17,554,900
1891		344,810	22	8,527,552	2,117,153	13,487,222
1892		252,560	22	4,277,552	2,893,309	8,596,712
1893		355,900	26	22,763,380	4,197,700	34,548,873
1894		503,900	28	17,451,172	2,190,500	25,458,729
1895		528,000	31	20,780,170	1,871,992	29,578,885
1896		803,800	35	18,016,544	1,249,695	25,271,754
1897		709,400	43	42,197,516	2,777,669	59,041,024
1898				9,600,000		

NOTE.—This table is based upon the reports of the inspector of fisheries for British Columbia as published in the annual reports of the Department of Marine and Fisheries of Canada. No data are available for determining the part taken by the hook-and-line fishery in the salt waters. In computing the total annual catch, the figures for which are only approximate at best, an allowance of one-fourth in weight is made for waste in the preparation of the canned salmon. A barrel of cured salmon is reckoned at 200 pounds, and fresh salmon have been estimated to average 10 pounds each where the records show the number marketed instead of the weight. This total catch relates almost exclusively to the salmon utilized in trade, both foreign and domestic, although some part of the fresh salmon may have been taken by the catcher to supply his own wants.

The quantity of salmon caught and used by the Indians is said to be very large, generally much exceeding the amount secured for market, though undoubtedly consisting in greater part of inferior species. Exact figures are not obtainable, but in 1886 or previously the quantity was estimated at 25,000,000 pounds annually, and these figures or their money equivalent were repeated in the official reports for several subsequent years. They were afterwards discontinued, however, as having too little foundation in fact.

SUMMARY.

In the account that has gone before, the conditions presented by this region are shown to be, from a fishery standpoint, both varied and perplexing—varied as to its natural features and resources, and perplexing in the division of its waters between two distinct countries. A long, deep, and rugged arm of the sea, fed by many mountain streams, invites a host of fishes from the ocean to seek shelter, food, and spawning-grounds. So closely does it resemble the outer coast in the purity, salinity, and coolness of its waters, that its fishes are identical, while the character of its surroundings greatly increases the opportunities for their capture. Among the useful species which enter here are several of anadromous habit, which occur in extreme abundance, being represented by one form or another throughout nearly the entire year.

It is doubtful if any other known region of no greater size affords so rich an assemblage of aquatic products or offers so many inducements for remunerative employment in their pursuit. To retain these benefits, so important for the region, will require the exercise of a wise forethought by those in power, as well as the accomplishment of a still more difficult task, the securing of harmonious action by the two nations whose interests are made inseparable through the extent to which the more prominent fishes cross the boundary line. As regards the salt waters the resources seem to be about equally divided between the two countries, but Canada has much the greater advantage in the matter of rivers, not in point of numbers, perhaps, but in the possession of the Fraser system, one of the most extensive resorts of salmon in the world.

While no marked decrease in the abundance of any species, except in two or three instances, has so far been positively recorded, experience teaches that in waters such as these a decrease is certain to appear unless due precautions are taken to prevent it, and they should be both timely and effective. Some of the open-sea fisheries in the North Atlantic Ocean have been prosecuted for centuries without apparently diminishing the supply, but the number of these is comparatively small. As a rule, man's influence has been felt, its extent varying with the natural limitations upon the movements of the fishes which are sought, the perfection of the fishing methods, and the persistence with which the latter are employed. The more restricted a fish's habitat, the smaller the sheet of water or the narrower the river, the more readily, in general, may the species be caught out. In conformity also with the same conditions are generally the opportunities for organizing systems of protection which shall be adequate to insure the perpetuity of each fishery.

A thorough regulation of the fisheries does not, however, imply a return to primitive or inferior methods of capture. There can be no reason for prohibiting the more perfect kinds of apparatus which are not actually vicious in their effects, provided the quantity of fish allowed to be taken is properly restricted. In the competition which pervades all industries it would indeed be unwise to require adherence to old-time practices, whereby the price of fish would be proportionally increased above that of other classes of our food supply.

It is to be recalled in this connection that the fishery products of a country are, as a rule, the property of the public as represented by the state or sovereign, despite the very prevalent idea that they belong solely to those who seek them. The fishermen rank practically as tenants, at some times paying for their privileges, at others not, when their status is more like that of a squatter on the public lands. Considering the ignorance or indifference with which the matter has always been treated by the people and the fishermen alike, it is not surprising that most of the older fisheries within restricted areas have been so greatly despoiled, and that newly discovered ones should be looked upon more for the opportunities for speculation they afford than as resources which can and should be made lasting.

The trouble arises chiefly from the fact that, except in a few respects, water territory can not be managed in the same manner as the land, in regard to which the individual is held primarily responsible in the economy of government. The land, for instance, is customarily divided up and passes under private control for such purposes as those of agriculture and mining. Crops are sown and harvested and rock products are extracted as suits the needs or pleasure of the possessor of the ground. The extent to which his industry is carried requires the dictates of no other law than that of self-preservation or advancement. Should he be neglectful or wasteful it redounds to his own injury, while with thrift and care his returns may be many times increased. If he fails in his obligations to himself the community as such is not supposed to suffer.

With regard to the fisheries it is very different. While certain sedentary products of the sea, such as oysters, may be farmed out, so to speak, and small ponds and streams may be treated as individual belongings, the great bulk of aquatic animals is not subject to private management. Most fishes, and especially those of much commercial value, are wanderers, whose confinement within artificial barriers is impossible. Thus, were the fisherman to plant, his crops would be shared by all alike; he could neither inclose them nor define them, nor would his personal efforts be of any avail in promoting the general welfare. The fisheries must, therefore, be administered upon by the state as a common holding, and the laws relating to them must not only regulate the behavior of those who participate, but also limit and define the extent and manner of their participation. This is entirely in line with the state control of waters for all other purposes, such as navigation, and in conformity with the customs of all nations.

It is, of course, to be understood that these remarks do not apply to extraterritorial waters, which are generally conceded to be outside the jurisdiction of any country, although several countries may unite in concerted action for their protection. And, furthermore, it is to be remembered that the Federal Government of the United States has not heretofore concerned itself with the regulation of the fisheries, except in some special cases, leaving to the individual States the entire control of such matters.

In the region to which this paper relates there may still be time to give the fisheries the full benefits of a wise protection before any of its branches shall have been appreciably impaired, but action should not be long deferred, as a decrease once begun is hard to check. The urgency of the matter is emphasized by the fact that elsewhere fisheries of the same character as the more important ones here have been among the first to suffer from indiscretion, and it is not to be expected that this region will furnish an exception to the rule. Of the regulations already in existence some are excellent, but as a whole, and more especially in Washington, they still fail to meet certain most essential requirements. In view of the fact that only a few branches of fishing are immediately concerned, however, not many additional laws are necessary at present, but it is very important to begin upon a course of procedure that shall be logical, and consequently effective. It is not suggested to carry the restrictions to a point where they would be either oppressive or unjust, but chiefly to establish a proper system of limitations before the strain upon the local resources shall become too great.

Unfortunately there is little definite information as a basis for legislative action, though possibly sufficient for the time in the directions where most urgency exists. It is, therefore, of the greatest importance to institute without delay a detailed and comprehensive investigation of the fishery products of the region with reference to their natural history and the extent to which their pursuit may safely be carried. The laws governing their capture can be perfected only in proportion to the sum of knowledge derived from such studies, which will also serve the further purpose of making these resources better known and of indicating new channels for their development.

Before passing to the special considerations which follow, it may be well to explain, what seems not generally to be understood even by many of the older fishermen, that the inland salt waters of this region are entirely divided between the two adjoining countries, leaving no intervening high sea open unrestrictedly to all comers. From the mainland at Point Roberts the boundary line extends due west partly across the Gulf of Georgia, and thence midway through the Canal de Haro and the Strait of Juan de Fuca to the ocean. The United States on one side of this line and Canada on the other have each complete jurisdiction over its share, whether navigation, the fisheries, or other subject is concerned.

For convenience of discussion, the useful fishes of the region may be arbitrarily classed in three groups: First, those which exclusively inhabit the salt water; second, those which belong entirely to the fresh water; and, third, those whose habit causes them to make periodic migrations between the sea and the rivers.

The salt-water fishes present the greatest number and diversity of forms, but only a few now figure at all prominently in the catch, and the majority may be regarded rather in light of a reserve stock, which will be drawn upon more and more with the increase of local population. In only one direction, probably, has the fishery progressed sufficiently to give cause for concern, and as a whole the resources of the group, so far as can be judged, may be considered as in good condition. The halibut is at present the most important of the marine species, chiefly because of the large demand for it in eastern markets. It has always been a favorite food with the Indians and one of their principal objects of pursuit, but there is no reason to suppose that its abundance was in any way affected until long after the advent of the whites. The rapidly growing trade recently inaugurated, however, has caused a heavy drain upon the different grounds tributary to the region, and while the large shippers depend almost entirely upon the outer and more extensive sources of supply, yet the inner grounds have had to stand a more active fishery than before; and as they are small, scattered, and relatively few in number, have quickly felt the effects of overfishing, a very appreciable decrease being reported. A remedy will be difficult to find, owing to the indefinite character of the fishery, but some restriction should undoubtedly be placed upon the quantity of fish taken.

Attention should also be given to the oysters, of which the supply can readily be increased and the quality improved by artificial cultivation. The fisheries for crabs and shrimps, and possibly for clams likewise, need supervision, the crustaceans being especially subject to depletion.

The purely fresh-water fishes are of very much less importance than either of the other groups. Among them are no species of extensive commercial value, but their protection is particularly desirable in the interest of local markets and sport fishing. International action is scarcely called for, however, unless it be to provide jointly for the enforcement of regulations to prevent illegal shipments across the border. In considering this group, the fact should not be lost sight of that the trout are among the worst enemies of young salmon, and that, in a region whose industrial prosperity is so largely dependent upon the salmon fishery, it would be unwise to jeopardize the latter for the sake of the trout.

The third group consists of the anadromous fishes, whose most conspicuous members are the salmons. The sturgeon also occupies a prominent place, the eulachon is locally important, and the Atlantic shad seems destined to gain a foothold. While it may yet be too early to take action regarding the species last named, the protection of the eulachon is of sufficient moment to be made the subject of inquiry.

While the supply of sturgeon is presumably still intact, this bulky fish, whose value is so greatly enhanced by its caviar, has been the first to suffer in each new fishery of which it has formed a part, and its early elimination from each as a prominent factor has been the rule. Attention here has been so closely concentrated upon the salmon, and the difficulties in the way of marketing the sturgeon have been so great, that the latter has been little fished for until within a few years. Its abundance, however, and the readiness with which it may be captured in both the fresh and salt water presage for it an extensive fishery, which has already taken form on the Fraser River and possibly elsewhere. In the salt water it is mainly caught incidentally in connection with the salmon, but with better means of disposing of the catch it is certain to be sought for specially.

The protection of the sturgeon may, in a measure, be secured by prohibiting the capture and sale of any but the mature sizes, by making reservations of the spawning-grounds, by instituting close seasons, and by restricting the amount of fishing. The Washington law of 1897 makes a close season from March 1 to November 1 and forbids the use of young sturgeon less than 4 feet in length. In British Columbia there is a general close season from June 1 to July 15 and a weekly close time corresponding with that for the salmon. Fishing is limited to the use of gill nets, drift nets, and baited hooks, the nets being not longer than 300 fathoms and having not less than a 12-inch mesh. They can not be set less than 250 yards apart. Not more than 6 hooks can be attached to each fishing line, and sturgeon under 4 feet long must be returned alive to the water.

The salmons, much more than any other fishes, demand immediate and serious consideration, as they constitute by far the most prominent fishery resource of the region and furnish the bulk of all its fishing. Without them the fisheries here would never have attracted special attention, and should they ever meet with the mishaps which seem elsewhere to have been the inevitable result of civilizing influences this industry must certainly become of comparatively slight importance. Not all the other species combined could nearly take their place as a source of local revenue.

The quantity of salmon which frequents these waters is beyond calculation, and seems even to be so great as to challenge human ingenuity to affect it in any way; but upon reverting to the conditions that existed in the northern Atlantic rivers less than a century ago we are led to recognize the omnipotence of man in this direction at least. The destruction there, to be sure, was due only in part to overfishing, but to-day the demands are much greater and the fishing engines more powerful. The catch need not reach the consumer immediately, but may be stored awaiting his pleasure or a rise in prices, and may be shipped, without injury, to the remotest quarters of the world. Such activity in the salmon fishery as now pervades this region, in common with the Columbia River and the Alaskan coast, was not dreamed of a few decades ago, and its effects are not measurable by the older standards. In this particular locality the growth of the industry has recently been much accelerated, and with the experience now acquired an increase in the catch from year to year is readily assured and will as manifestly be demanded. The question is, Where will it end? The circumstances have been so unusual that time alone can solve the problem. There appears so far to have been no appreciable decrease in any of the species, but, however abundant each may be, it seems impossible that this condition could continue long.

The situation presented by the salmon fishery is briefly as follows: Six species of the group occur in this region, all edible and of commercial value, but graded for the market in accordance with the quality, the color, and the firmness of their flesh. The quinnat and the steelhead are preferred for the fresh trade and the sockeye for canning. The silver salmon, the humpback, and the dog salmon are utilized in various ways, but whether fresh, salted, or canned they constitute an inferior grade and generally sell at a lower price.

With the variety and abundance of its salmon the region combines physical characteristics which greatly increase its importance as a producing district. Its rivers, instead of emptying on an open and exposed coast, have between them and the ocean a large and quiet sea, with many long channels, through which the fish must pass in the journey to their spawning-grounds. The advantages of this intermediate body are two-fold, in that it greatly enlarges the fishing area and brings the fish of every species in striking distance while still in the salt water, when their condition is certain to be good. With these unusual opportunities for following up the schools the necessity for adequate regulations must be manifest to all. The more important forms are naturally most actively and persistently sought after, leaving the others somewhat in reserve, but not to such an extent as the general accounts might lead one to suppose. The silver, humpback, and dog salmon are all employed for canning on the United States side, and throughout most of Puget Sound proper they are the only species which can be secured in sufficient quantity for that purpose. Any system of protective regulations should therefore contemplate providing for the welfare of the entire salmon group; but with some species there is much greater urgency for action than with others.

Among the salmon, and in fact among all the fishes of the region, the sockeye occupies the place of most prominence. While it holds this position primarily by virtue of the deep color and excellent canning quality of its flesh, its importance is equally due to its exceeding abundance, greater in most years than that of any other species in the localities it frequents, to its regular and well-defined movements, and to its relatively early season, which insures the passage of most of the schools past the fishing-grounds quite well in advance of the spawning period. The principal disadvantage under which the species labors arises from the fact that its spawning-grounds are almost entirely restricted to two rivers, and in greater part to one, the Fraser. After entering through the Strait of Juan de Fuca its course is so well known and its presence so readily detected in many favorable localities that it is compelled to run the gauntlet of a very active and persistent fishery, which is stimulated by both local and international rivalry. While the movement of the species may not continue over five or six weeks, the amount and effectiveness of the apparatus employed for its capture more than counterbalance the shortness of the season. Every year adds new fishing stations and increases the quantity of nets about the older ones at a rate that threatens overfishing at an early period.

While the main body of the sockeye passes north through the two channels on either side of the San Juan Islands, no noteworthy fishing sites had been discovered south of Lummi Island at the last report. The next and by far the best of the Washington grounds are about Point Roberts, the principal trap-net locality, where the question of greatest interest is to determine what proportion of the fish moving about the point strike within the range of the long strings of nets. The Canadian fishery is concentrated in the discolored water of the Fraser River from above New Westminster to some distance off the delta, where the conditions are such, moreover, that the entire run of sockeye might be practically wiped out by an extreme multiplication of the drift nets. In fact, in its possession of the Fraser River British Columbia controls the main situation as regards this species, having within its power the means of inflicting an incalculable amount of harm; while, on the other hand, the preservation of the sockeye requires the concerted action of both countries.

The conditions are more serious in regard to the run of sockeye which passes through Skagit Bay and into the river of the same name than with the northern run. This is chiefly due to the narrow and shallow character of the bay, which permits the arrangement of a close network of apparatus, and judging from late accounts the fishery there is being pushed with great persistency and with little thought of the future. Any and all kinds of nets may be employed, which, in a restricted area, is a great misfortune, and in other ways the laws are also quite inadequate.

The feature of periodicity in the relative size of the annual runs of sockeye is of great interest, and its causes have given rise to much conjecture. Should its origin have been due, as some suppose, to local influences affecting the species at its spawning-grounds, it would point to a source of menace in that connection, but time has shown that there is little occasion for anxiety on that score, and if the efforts now being made to equalize the runs through artificial propagation turn out successfully, all such natural dangers will be minimized.

A much more important phenomenon is the great mortality which affects nearly all salmon at spawning time, and in the case of some species seems to work an almost total destruction, the sockeye being one of the heaviest sufferers in this respect. This mortality has a practical significance in that if none of the ascending fish are to return again to the sea there is no occasion for protecting them with the object of saving any for subsequent fishing seasons, and all that need be done is to assure a sufficient run past the nets to provide for the requisite amount of spawning.

With the information now at hand, however, no measure can be set upon the quantity that should reach the spawning-grounds, and for some time at least, if not forever, the question must remain entirely problematical, the only safe course to pursue being to allow the widest margin possible.

The quinnat has not the same position here that it holds on the Columbia River, in consequence of its being apparently less abundant and also because of the large proportion of off-colored fish, which has made its pursuit less active than would otherwise have been the case. Nevertheless it ranks as the most important species for the fresh market, for which purpose it is principally used, its employment for canning during the season when it is chiefly taken being made impracticable by the high prices which then prevail. The introduction of stock from the Columbia River, with the object of securing a larger run of the deeper-colored fish, was contemplated by the Canadian government some years ago, but the plans were never carried out. The experiment would have been watched with keen interest, in view of the problem involved as to whether the lighter coloring of so many individuals is simply due to local influences which might also affect the imported fish.

The rapid growth of the fresh trade is strongly stimulating the fishery for the quinnat, and its welfare should be carefully looked after in the salt water and the smaller streams, as well as in the larger rivers where its pursuit is naturally most extensive.

The steelhead is also chiefly utilized in a fresh condition, the fishery being mainly a winter one in the lakes and rivers, although catches are made at other seasons and to some extent in the salt waters. Its predaceous tendencies and supposed habit of feeding on the young salmon of other species have been suggested as sufficient reasons for denying it all protection, but it would be exceedingly unwise to act upon this proposition until its life-history has become better known. In British Columbia the general provision against winter fishing for any of the salmon has interfered with but not wholly prevented the capture of this species at that time of year. The circumstances show the necessity for regulating its fishery on a different basis from the other forms.

Of the remaining members of the group the silver salmon is the most important and is the one most likely to be drawn upon in making up a shortage in the cannery pack of sockeye. It is most extensively utilized south of the boundary line, where the principal catches are obtained by means of purse seines in the salt water. It is also taken in the trap nets, when left out late enough in the season, and by other methods.

While the humpback, whose appearance is strangely confined to alternate years, and the dog salmon have a lower standing than the foregoing, yet they are of sufficiently good quality to entitle them to a high rank among the food-fishes of the region. Both are canned to some extent in Washington. The humpbacks are taken in large quantities in connection with the later runs of sockeye, especially in the trap-net fishery, when they are customarily discarded, but not until after they are dead, causing an extensive waste.

The dog salmon seem recently to be meeting with increased favor. Their condition is said to be excellent as long as they remain in the salt water, which is for a considerable period after their first appearance, and they are now being utilized in connection with the fresh trade. The silver, humpback, and dog salmon, like the quinnat, spread to all parts of the inclosed sea and enter most streams, even those of small size. With this wide range of spawning-ground, their chances of survival are much greater than with the sockeye, while the extensive area over which they must be sought in the open-water fishery gives them an additional advantage. The activity of their pursuit, however, is certain to increase, and should there ever be a decided falling off in the supply of sockeye it would be greatly stimulated.

It will be observed, therefore, that while the requirements of the sockeye have already been ascertained with some degree of definiteness, much uncertainty exists as to the amount of protection that should be accorded the other species at the present time. The problem they present is more complex as a whole and will require more study to unravel the details, but there is no reason to suppose that it may not be as satisfactorily dealt with. None of these species, unless it be the quinnat and steelhead, seems to be in immediate danger, and if the ordinary precautions which should be taken in regard to any salmon fishery, such as safe-guarding their spawning, be immediately enforced, detailed regulations in respect to other matters can possibly await further investigations, if not too long delayed. The primary requisite in the protection of salmon is that they shall have such freedom of access to their spawning-grounds as will insure the perpetuation of the species without decrease. This provided for, it makes little difference, as regards the welfare of the species, how or where the fishery is carried on.

It is unfortunately impossible to determine what proportion of any run of fish may safely be taken, and it would probably be impracticable to utilize that information were it obtainable. While theoretically any disturbance of the natural supply might be expected to cause a decrease, experience teaches that a certain amount may be removed each year without appreciable effect, as instanced by the large Indian fishery in this region, which has been going on from time immemorial. Between the practices of the Indians and those of the modern fishermen, however, the difference is very great, and it is with the latter that we have now to deal.*

Commercial fishing for salmon has become extensive in this region only within a comparatively short period, but while in Canada it has been practically restricted to drift-netting, in Washington nearly every form of apparatus known to be adapted to the purpose has already come into use. Trap nets were the latest to be introduced, but are now recognized as the most effective kind in salt water. Purse seines came next before the traps, and are probably to be considered as only second to them in importance. Still older are the drag seines and gill nets, the latter employed in both the salt and fresh water. Hook-and-line fishing is one of the minor salt-water methods, applicable only to the capture of the quinnat and silver salmon, but much of the local supply during some seasons is obtained by this means.

The Indians still use their reef nets along the route of the sockeye, and their spears and dip nets in the upper river courses, where at times they also build a small and rude form of weir. Wheels have been tried in one place, but they seem unlikely to gain a foothold here. While in principle there can be no objection to the employment of all the legitimate forms of apparatus, the Canadian system has the greater advantage from the standpoint of protection, in that a much simpler code of regulations suffices. It is to be borne in mind, however, that the Washington fishery is prosecuted under greater diversity of conditions, and to restrict it along a single line would mean its curtailment many fold, an extreme measure which would not be justifiable.

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*Since this paper was prepared we have received a copy of the report of the State fish commissioner of Washington for 1898, from which are taken the following extracts regarding the salmon fishery for 1898 and the supposed evidences of a decrease in certain streams. Should the statements concerning decreases be well founded the necessity for decisive action by the authorities of Washington is more pressing than the evidence in the possession of the writer had led him to suppose:

"The report from the district of Puget Sound shows a still more marked decrease in the output in the salmon fisheries than does that of the Columbia River. The enormous run of Fraser River salmon during the season of 1897 increased the annual output of this district to a remarkable degree. * * * The run of other classes of salmon for the season of 1897, with the exception of the Fraser River fish, was not materially larger than in former years. The decrease in the output of the past season is entirely in the early runs of salmon. The fall varieties show an increased catch over the year 1897. The increased fall output was largely due to the shortage of the spring catch and energetic work on the part of the fishermen and canneries to make up for the spring shortage by a large pack of the fall varieties. * * * The numerous streams tributary to Puget Sound have in years gone by teemed with what seemed to be an inexhaustible supply of salmon, and while in a number of these streams the supply does not seem to have diminished materially, in many of them there has been a wonderful decline, so much so that complaints during this season, and even during the season of 1897, when there was a phenomenal run of sockeye salmon on the sound, have come to us from different localities in which a great decrease of the run of fish on certain streams has been noted. During the season we have examined some 14 different rivers tributary to the sound, with a view to better understanding the conditions prevailing with regard to the run of fish, and also for locations available for the establishment of hatcheries. In every instance, from the people and fishermen living along the streams, has come the complaint of remarkable decrease in the run of salmon. While this may be attributed to some extent to an off year, yet we find that during the season of 1897 very much the same conditions prevailed in many localities."

Except for a small amount of hook-and-line-fishing in the salt water, drift gill nets are the only appliances allowed in the commercial fishery for salmon in this part of British Columbia. Their use is, moreover, almost entirely confined to the lower tidal portion of the Fraser River and that part of the Gulf of Georgia immediately adjacent to its mouths, where the salmon runs are very much more extensive than elsewhere, and where the discolored water effectually hides the twine during most of the open season. Although there is room for the expansion of this fishery to an almost unlimited extent, and certainly to the imminent danger of exhausting its resources—a condition which might apply, however, to any effective method adapted to the same surroundings—yet the simplicity resulting from the use of only a single kind of net makes the system most amenable to regulative measures and one greatly to be preferred. For the drift net, as compared with the trap and purse seine, the benefit is also claimed of dividing the fishery among the greatest number of fishermen, thus providing a means for preventing a monopoly of the work by the larger operators.

Experience has shown the necessity for only two kinds of these nets, distinguished solely by the size of the mesh—a larger one for the quinnat and a smaller one for the sockeye and other species of corresponding size. The former may be employed without interfering with the smaller salmon, the latter without taking the larger forms, and thus an opportunity is afforded for treating the two groups apart, for closing the fishery for one while the other remains in season. The length of the net in both classes is limited by law to 150 fathoms, and the depth, by custom, to about 50 meshes. These dimensions are reasonable and convenient for handling by the small boats employed in their use.

Formerly a limitation was placed upon the total number permissible in the Fraser River district, which up to 1891 never exceeded 500. Then all restrictions of this character were removed, and every bona-fide fisherman who was a British subject and a resident became entitled to a license. Canners and dealers could obtain from 7 to 20 licenses apiece, though the limit to canneries was reduced in 1898 to 10. The effect of this modification of the law was felt at once, for in 1892 the number of nets increased to 721, and in 1893 to 1,072, in 1894 to 1,666, and in 1895 to 1,733. In the last-mentioned year the total length of the combined nets amounted to 528,000 yards, while in 1896 it had reached 800,000 yards. The principal weakness in the Canadian regulations is in regard to this provision, which practically admits of an unlimited extension of the fishery. The claim is not here made that the number of nets has already become excessive, though possibly it has, but extreme watchfulness is necessary to keep the quantity within proper bounds. A part of the recent great increase in the nets is ascribed to the hard times prevailing in connection with other pursuits which has led to an influx of many inexperienced fishermen, whose catch is said to have been relatively small. The power exerted by the large amount of netting is strikingly illustrated in the year of big runs of sockeye, when the catch becomes enormous and sometimes far exceeds the capacity of all the establishments—including the canneries—concerned in preparing the fish for market. Considering the shortness of the season, the size of the fishery is all the more remarkable.

The manner of using the nets on the Fraser River is also subject to certain regulations. They must not, for instance, obstruct more than one-third the width of the river and must be kept at least 250 yards apart. These measures are designed to maintain an open passageway for the salmon, in which they are protective, and also—the latter one at least—to prevent one fisherman from interfering with another. In principle they are correct, and they would also be good in practice, except that it has not been found possible to carry them out effectively, especially since the nets have become so numerous. Moving continuously as they do, they are to a large extent uncontrollable, while the tendency to concentrate the fishing over a small area near the river mouths leads to some crowding. In some places the river channel is not large enough to leave two-thirds of its width free when the net is placed, and again it is entirely possible to alternate the nets so as to virtually negative the intent of the law.

Although gill nets were among the earlier appliances utilized in Washington, they have never been employed there as extensively or systematically as in British Columbia. They are used in both fresh and salt water, either set or drifting, as suits the pleasure of the fishermen, and are subject only to restrictions governing their distance apart and the width of the river which they may occupy. In certain places, as in Skagit Bay and River, they have become a prominent feature, and their number may be expected to increase. In Skagit Bay competition with the trap nets has engendered an intensely bitter feeling, leading to a strenuous though ineffectual effort on the part of the gill-netters to secure the abolition of the larger nets.

The use of trap nets is prohibited in British Columbian waters, except in the upper part of Boundary Bay, where the fish taken are headed toward the neighboring traps across the line. Within the past few years these nets have become a prominent feature in Washington, where they rank as the most effective apparatus employed in the salt water. Their introduction had special reference to the sockeye, which had previously been mainly fished for in sheltered places along the shores with seines and gill nets. They met with very indifferent success at first, but experience soon dictated the necessary changes in construction and position to insure good catches. The earliest trials were made at Point Roberts, which has proved to be by far the most profitable location for their use, and where their number has always exceeded the total number elsewhere. The other principal fishing-grounds are near Village Point, on the outer side of Lummi Island, the southern end of San Juan Island, and Skagit Bay, all lying in the pathway of the sockeye runs.

In the protection of this species, the one most urgently requiring such attention, the trap nets, therefore, figure most conspicuously and the importance of fixing their proper limitations will very readily be appreciated. With suitable restrictions upon the manner of their employment, the greatest danger lies in the tendency to multiply their number unduly, and in this direction there is reason to fear that much harm may soon be done. The trap nets are mostly located in exposed positions, where it is necessary to construct them of unusual strength, but in spite of this precaution they seldom last a single season without repair. They are consequently expensive to build and operate, which places them beyond the means of the ordinary fishermen, and are in fact almost exclusively run by the canneries or directly for them. In size they generally much exceed the pound nets of the Great Lakes, after which they were originally patterned, and, with the improvements recently introduced, are certain of securing large catches whenever the sockeye are abundant. Thus perfected, they have greatly cheapened the cost of capture and produced a sharp competition with the gill-net interests on the Fraser River as well as in Skagit Bay. The efforts made by the gill-netters in the latter locality to secure the prohibition of trap-net fishing throughout the Puget Sound region had apparently no reference to the preservation of the salmon, but seem to have been directed solely against the larger fisheries, to which the great prosperity of the region in recent years has undoubtedly been chiefly due.

The number of trap nets that might safely be allowed in connection with the sockeye fishery depends upon information not yet available. It was not supposed that there were too many in 1895, when they were last studied, but a very large increase has taken place since then and the limit of safety may have been passed. The danger is most imminent in Skagit Bay, where the run of sockeye is much smaller than toward the Fraser River, and where the opportunities for establishing trap nets are exceptionally good. In this narrow and shallow area these devices, supplemented by other forms of apparatus, may readily be so multiplied as practically to barricade the way toward the river, preventing not only the sockeye but the silver salmon as well from reaching their spawning-grounds, and virtually breaking up the runs in this locality.

If, as claimed, scarcely any young salmon are ever taken in the traps, the question of the size of mesh is not material, unless it be in the interest of other and smaller fishes which may be caught in the same connection, but regarding which we have received no positive information. The mesh should certainly not measure less than 3 inches in the crib and 6 inches in the leaders. A somewhat larger size could probably be employed without detriment to the salmon catch, but floating seaweed is abundant in the region and the larger the openings the more readily these weeds become attached to the net, weighing it down and closing the meshes. The size of the crib is of practically little importance compared with the length of the leader and the scope of the wings, by which the capacity of the net is chiefly to be measured, because however large the crib may be it will only receive the fish which are directed toward its opening. Two thousand feet is as great a length as should ever be allowed for the leader, and in some locations this would be excessive. It may also be found advisable to limit the size of the wings, for they are practically only adjuncts of the leader and of great effectiveness.

But however important it is to restrict the size of the nets, it is still more important to regulate their arrangement or relations to one another when several are fished in the same place. It is a common practice in many localities to join such nets in a string of from two up, according to the width of bottom suited to the purpose. Pound nets on Lake Erie have been thus combined to cover a distance of even 8 or 10 miles without a single break. The longest string in the Puget Sound region in 1895 consisted of three nets at Point Roberts, which extended off from the beach somewhat over a mile. The effect of this arrangement is evident. Over the width which the string occupies substantially every salmon coming toward it is destined to become entrapped. There is little chance for any to escape and a very poor showing for succeeding traps near at hand. Again, though they be not in strings, they may so alternate in position that the salmon which pass one net strike directly against the leader of another. Thus the interests of the fishery demand, where a number of nets are operated near together, that their distribution be so fixed as to permit a fair proportion of the salmon to work their way from among them. Otherwise, with the rapid multiplication of traps which is going on, a time may come when the progress of the salmon will be so barred at intervals as to prevent their ever reaching the Fraser or Skagit rivers. This at least applies to the fish which skirt the shores, and it seems reasonable to suppose that a large share do so at one point or another. In any event, it would be quite injudicious to subject too large a proportion of the fish to capture at any single place. The matter may be definitely regulated by statute as regards the strings, but in respect to the alternating arrangement a consideration of local conditions may be required in each case.

The opportunities are few for a lineal arrangement on the Washington coast, and it is doubtful if any string could be advantageously extended beyond the distance given for the long line off Point Roberts. It was suggested by the Joint Fisheries Commission in 1896, however, that the proper limit has there been exceeded, and that no more than two nets, with leaders not over 2,000 feet long in each, should be allowed in any string. Between the two nets, moreover, there should be an opening, a means of escape for a part of the salmon, and a passageway for boats. Its minimum width in the regulations submitted was placed at 100 feet. It would be better to make it 500 or 600 feet. And it was further provided that the inner end of any leader should never come into a less depth than 1 fathom at low tide. Laterally successive nets should be separated by at least 2,500 feet, approximately half a mile. The greater the distance in this respect the less are the evils to be expected from any alternating arrangement.

By the act of 1897 the legislature of Washington recognized the justice of these requirements. Besides prohibiting the use of trap nets and other fixed appliances in rivers or within 3 miles of their mouths, as well as in Deception Pass and in water of greater depth than 65 feet, this law limits the length of leaders to 2,500 feet and provides for an end passageway between all traps of at least 600 feet and a lateral passageway of at least 2,400 feet.

The purse seines, though very unlike the trap nets, are nevertheless to be classed with them as having great individual scope and requiring a considerable outlay for their operation. They are chiefly fished in the upper part of Puget Sound for the later-running species, especially the silver salmon, of which they take enormous quantities. Elsewhere they are not much utilized, and in connection with the sockeye fishery they cut no figure, although sometimes set in the neighborhood of the traps at Point Roberts. The purse-seine fishery has not been sufficiently studied to determine how far it should be restricted, but the important part played by these nets in the removal of salmon from the salt water and the almost certain future increase in their number make it desirable that the subject be thoroughly considered. Their use is now prohibited within 3 miles of the mouth of any river.

The drag seine was one of the earliest appliances, if not the first, employed in this region for taking salmon, and its use has been continued and increased. The fishery by this means, however, is mostly scattered and irregular, being mainly conducted on a small scale in different places to meet local wants. In some localities more extensive operations are carried on, as about the mouths of the larger rivers at the period when the salmon begin to enter, and in certain parts of Puget Sound to supply the canneries with fall fish. Some fishery experts regard the drag seine with unqualified disfavor under all conditions, but this universal condemnation is far from merited. While they may possibly be hauled surreptitiously rather more easily than most other kinds of nets, within proper limitations their use is quite as legitimate, and to abolish them here would be to deprive the inhabitants of thinly settled shores of one of their most ready means of securing food. They are not now permitted to be hauled in any river or within a mile of its mouth outside.

The primitive reef nets which well answered the requirements of the Indians, although now used for commercial purposes, are rapidly going out of use, and before many years they will doubtless cease to figure among the methods of the region. With an exceedingly limited scope at the best, no occasion exists for giving them consideration in connection with any scheme of regulations.

Only the quinnat and silver salmon take the bait in salt water and are fished for by hook and line, and this occurs on altogether too small a scale to merit attention from the standpoint of legislation. In fresh water the steelhead is the only species which might be caught in the same manner, but we are not informed to what extent it is so obtained, if at all.

The well-known practice of spearing salmon in the upper, shallow waters of a river, long followed by the Indians, has also been taken up by the whites, and in some sections is extensively resorted to by both for domestic purposes, as well as for making local sales among the settlers. With salmon as abundant as they are at present, the danger from this source is much less than on the salmon rivers in the east, where this method is enjoined. In at least some localities, however, the practice should be limited and possibly forbidden, this being especially the case with reference to those streams in which the sockeye and quinnat spawn. It is also generally so near the spawning time before this method becomes effective that the fish so taken are not in the best condition for food, being unsuited for canning or the market trade.*

Fishing has always been one of the chief occupations of the Indians, one of their principal means of securing food. Though of the wilderness, as the salmon themselves, and making use of crude appliances, their catches have nevertheless been large, and yet have seemed to produce no appreciable effect upon the abundance of the supply. Thus the advent of the whites found the fishery stock intact, so far as can be told. The Indians have greatly diminished; of the remnants many have been changed by civilization into commercial fishermen, employing for that purpose the old-time reef nets, gill nets, seines, and hooks and lines, to all of which reference has just been made. Those which still hold to the primitive methods of fishing for their own needs, chiefly in the upper parts of rivers, are comparatively few. Their apparatus consists of spears, dip nets, and weirs, the last being a crude form of trap, which, though not extensively employed, can be so placed as practically to bar the entrance to important spawning grounds. The spear has already been discussed; the dip net occupies a relatively inconspicuous position from the standpoint of its catch.

While under the original conditions the use of these several methods to the fullest extent required by the Indians may have caused no harm, with the heavy market fishery now in progress it may be necessary to impose some limitations. The steady drain near the mouths of the principal rivers makes it important that those salmon which reach the upper waters should be interfered with as little as possible. The use of the weir at least should be entirely prohibited, as has been done in British Columbia. It is important to note in this connection that the Indians have been guaranteed certain treaty rights which should be respected. They are fast yielding to civilization; their power for harm is already infinitesimal when compared with the whites, and seems likely soon to cease altogether. In Washington no restrictions are put upon the Indians in fishing to supply their own needs. In British Columbia they are permitted to take salmon for their own use by their customary methods, aside from the weirs, at any time and anywhere except on the spawning-grounds. In respect to the last provision many violations are reported and require attention. In all commercial fishing they are subject to the same regulations as the whites.

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* By the act of March 13, 1899, it is made unlawful to fish for salmon by any means except angling above tide water in the Nooksack, Skagit (up to the town of Hamilton), Stillaguamish, Snohomish, White, Nesqually, and Skokomish rivers. The State fish commissioner may also close to fishing any stream or river of Washington emptying into Puget Sound whenever he shall consider that the protection of its food-fishes require it.

While suitable regulations as to the character and manner of using the different kinds of apparatus might be expected to provide for the escape of a sufficient number of fish to cover all the requirements for spawning, yet in practice, and this holds true especially with the salmon, it has been found essential to supplement the restrictions already referred to by a total cessation of fishing during more or less of the period when the fish are running. The laws of Canada seem quite ample in this respect, but in Washington the matter has not been fairly treated. Although the need of such regulations may not appear important while the supply of salmon continues large, yet we can not question the benefits already derived from the measures of this kind enforced on the Fraser River, and urge their early adoption elsewhere as one of the surest means of maintaining the supply of the choicer species.

The most suitable periods for the close times and their proper duration give rise in this region to questions of some perplexity. Had we to deal with only a single species, or at the most with two differing so much in size and season as the quinnat and the sockeye, there would be little trouble in reaching a satisfactory arrangement, but with six species appearing at successively later periods and yet overlapping, sometimes quite markedly, in their runs, many difficulties are presented. The time most commonly selected for the salmon is toward the close of the run, when it has the additional advantage of preventing their capture and sale when they are in the least acceptable condition for food. Doubt has often been expressed as to whether this protection of the later-running fish is of any benefit to the earlier runs of succeeding years, on the supposition that salmon run at the same time and to precisely the same places as their progenitors, but until these questions have been more positively decided there seems to be no reason why the customary practice should not continue.

In British Columbia the subject is very much simplified by the facts that the commercial fishery is directed mainly toward the quinnat and sockeye and is restricted to a single method. The larger mesh of the quinnat drift nets can be used through the sockeye season without interfering with the latter species, and the reverse is true with regard to the smaller mesh adapted to the sockeye. Thus a close season may be arranged for one species while fishing for the other still goes on. According to the existing Canadian regulations the smaller-meshed nets must be withheld from the water from August 25 until September 25 of each year, when the sockeye have ceased running and only later species can be taken. From October 31, again, until July 1 of the following year their employment is entirely prohibited. Between August 25 and September 25 protection is afforded the latter half of the humpback run and the early part of the silver salmon run, while the dog salmon, being still plentiful after October 31, enjoys the benefit of the long close season, which continues through the winter. The open season for the large-meshed nets is from March 1 to September 15, and thus only the very beginning and the closing part of the quinnat runs are free of any interference from the nets.

In Washington the variety of apparatus makes the adjustment of close times quite difficult to decide. The trap net is omnivorous, taking whatever comes its way, but being generally utilized only for the sockeye, it has commonly had little relation to other species. The drag and purse seines, while better adapted for some species than for others, can be considered as selective only as their use may be directed toward the schools of one variety or another, and are mainly employed in the late summer and the fall. When the sockeye run is small the trap nets may be continued in place for the purpose of taking other species, and the rapid increase in the fishery will doubtless tend to their employment during a greater part of the year than has heretofore been customary.

Just how a close-time measure should be framed so as to benefit all the species under these complex conditions is a matter requiring further and careful study, especially as the main part of the fishery is so essentially a salt-water one. It is to be assumed that such a scheme is practicable and it is further to be hoped that steps may soon be taken toward its realization, but in the meantime the interests of the sockeye and quinnat should not be allowed to suffer. Close seasons could readily be arranged for each of those species in both the salt and fresh waters and they should at once be instituted. Washington has no close-time regulations whatsoever applicable to the salt water. On the rivers fishing is stopped during April and again from October 1 to November 15.* Only the quinnat could be benefited by this first close season, and the silver and dog salmon by the second. The latter part of both the sockeye and quinnat runs should certainly be protected by regulations fully as comprehensive as those in force in British Columbia, and it would be better if the close time for the quinnat should begin at even an earlier date than there.

Some of the difficulties presented by the annual close times may be overcome by the introduction of shorter periods of rest at intervals during the salmon season. This measure is not suggested as a substitute for the other, but as supplemental to it and of great additional benefit. It is provided for in British Columbia, where all net fishing is stopped by law during the thirty-six hours from 6 a. m. on Saturday to 6 p. m. on Sunday of every week. The special advantages of this weekly close time are several. It assures the ascent to their spawning-grounds of fish of the same species at different periods during the entire season, thus meeting the objection raised against the fall close time as protective only of the later runs. There is likely to be considerable variation in the duration of the season, which, in the case of the sockeye at least, may end before the date appointed for the fall close time. The weekly periods make up for this discrepancy and also afford fishermen a regular period of rest from their work, which in the case of those who are in the regular employ of large establishments is not unwelcome, especially if it falls mainly upon Sunday, as is customary.

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*By act of 1899 the latter close season extends from October 15 to November 15.

The extension of such a regulation to the waters of the State of Washington, so far as this can be done advisedly, is strongly to be recommended. The measure is most important in respect to the sockeye, and its utility is most evident on the rivers, where the salmon are pressing rapidly toward their spawning-grounds. In even the salt waters the sockeye move so quickly along their defined course that a weekly close time in their interest should be favorably regarded. The inner salt waters are to them apparently almost a continuation of the rivers in which their spawning-grounds occur. A period of thirty-six hours may be too short to permit the fish some distance out in the sea to pass the upper limit of the nets, and it may, upon further inquiry, be found advisable to begin the close time somewhat earlier in the salt water, but even should it for the present be made uniform throughout, it is scarcely to be doubted that the relative number of fish that reach the spawning-grounds would be increased. There is some question as to the benefits to be gained by other species through a measure of this kind, as most of them at least remain in the inner sea for a longer time than the sockeye, and some for quite a period, as in the case of the quinnat. They should undoubtedly be so protected in the rivers and about the mouths of the rivers.

The close-time question with reference to the steelhead requires to be considered apart from the other species, in consequence of the fact that its movements and spawning take place at quite a different season. The growing demand for the species and the opportunities for its capture in the fresh water during a long period make it very important that its welfare be not neglected from this standpoint.

In a new region, where existing conditions have favored so bounteous a supply of salmon, it is quite unnecessary to consider for the present whether their ascent is anywhere impeded by natural obstructions. The introduction of fishways or the clearing away of barriers might in some localities open up new spawning-grounds, and such measures may in time be called for, but the gain would scarcely be realized while the salmon remain as abundant as they are, and the expenditure required would be considerable.

Of artificial impediments, aside from the nets, there appear to be few in any of the fresh waters, and, in fact, no complaints of such have reached the writer. The building of dams in the pathway of the fish should be prevented as far as possible, and if any are allowed they should have openings of ample size to permit the passage of the immense schools which ascend these streams. On many of the Atlantic rivers much harm has been done the salmon by the rubbish from sawmills passing into the water, a practice which has been followed here to some extent. The prohibition against it in British Columbia is said to be enforced, but in Washington and especially on the Skagit River, if the reports be true, the sawdust and other refuse have been dumped into the water so extensively in places as to threaten serious injury. As this material can readily be disposed of on land by burning or otherwise, there is no excuse for continuing the custom.

There seem at present to be no sources of general pollution, such as the drainage from large communities, which need to be considered from a fishery standpoint, but they are likely to appear with the increase of population. The same is true regarding obnoxious waste products from extensive factories except in one particular, resulting from the fisheries themselves. This exception is furnished by the salmon canneries in consequence of the immense amount of offal which they produce and which is customarily thrown into the water. In Washington the canneries are all located on salt water and their offal gives no trouble, as it disappears quickly and entirely. It is different on the Fraser River, where the many canneries are mostly collected near its mouth.

Several measures looking toward the disposition of waste materials without detriment to any interest have been adopted by the Canadian government, but none has long been enforced, the remedies being ineffectual in some cases and impracticable in others. Offal carried out to the gulf and dumped off the mouths of the river is liable to be washed ashore, while its manufacture into oil and fertilizer on a large scale has heretofore proved unsuccessful. The old practice of allowing it to fall into the water of the river in a fresh condition as fast as it is produced has, as a whole, given the best results, and is the one quite universally pursued, and there is no specific evidence that it has been detrimental to the welfare of the salmon; nor except in a few localities has there been complaint that it was injurious to the health of the community. When thrown into the current fresh the offal seems to be quickly dissipated, and it produces a nuisance only when placed in quiet, shallow water or in eddies, which tend to retain it along the shores or to carry it into the adjacent sloughs. If held long enough for decomposition to set in, it tends to float at the surface. Pending the discovery of some better way it seems advisable to sanction the present practice under due restrictions, the fishery officers being empowered to prevent its deposition wherever it would be prejudicial.

The fishermen of this region are quite alive to the benefits of fish-culture, and many of them, in fact, have so strong a faith in its efficacy as to lead them to magnify its possibilities and to conclude that through its agency the necessity for any regulations may be dispensed with. They argue that if the eggs be secured in sufficient quantities and the proportion of survivals be as great as claimed by some fish-culturists, why should not the supply of fish be capable of maintenance and even of unlimited increase by this means alone? There is no evidence, however, that would warrant us in anticipating so large a measure of success either here or elsewhere, and the time of unrestricted fishing is undoubtedly as far distant now as ever.

The artificial propagation of the sockeye was started on the Fraser River in 1884, and since 1887 the number of fry and advanced eggs planted yearly has ranged from 2,400,000 to something over 6,000,000. Its primary object was to equalize the annual runs of that species, to make them larger during the off years. The abundance of fish during the past few seasons has been very commonly ascribed to this cause, the quantity having apparently become greater in all years. While it is to be hoped that there is some foundation for this explanation of the increase, it is well to bear in mind that the annual output of fry, especially after allowing for the inevitable mortality among them, has been much smaller than the annual catch of adult fish, and scarcely sufficient to make itself felt to anything like the extent noted within so short a period.

On the Skagit River fish-culture began in 1896–97 with an output of 5,500,000 sockeye fry; in 1898, 6,000,000 were planted, while the number of eggs collected in the fall of 1898 was 7,500,000. The opportunities for collecting the eggs on this stream are exceptionally good, but it is still too early to expect results. The quinnat offers a much more interesting field for experimentation than the sockeye in the direction of improving the color and quality of its flesh by the introduction of fry from the Columbia River—a project suggested some years ago, but never carried into effect. While the success of such a measure could only be determined by actual trial, it seems to be worth the effort, and the transplanting presents no difficulties that could not readily be overcome. An increase in the abundance of the species is also called for.

A great waste of salmon occurs in connection both with canning operations and with the fishery, which may be expected to continue as long as fish are plentiful. Lacking an incentive to economize in the preparation of the catch, little pains are taken by the cannery operatives to cut closely in removing the heads and fins, and much edible meat is thus lost. The exercise of greater care would add to the expense of canning without material gain under existing circumstances, but in time much of these rejected parts will come to have a value. The more serious waste, however, results from overfishing in years of great plenty, as in the case of the sockeye on the Fraser River, where in some years the catch is much larger than can be handled. Immense quantities are thrown away, prices fall, and the independent fishermen lose heavily, while the canners and dealers who control the market can so regulate the catch by their own boats as to keep it within the proper bounds. The impulse to increase the amount of fishing in the good years is quite natural, but it would seem as though the number of nets allowed might be adjusted to suit the conditions of each season, were the requisite discretionary powers conferred upon some local authority. The matter can not be remedied through the medium of an inflexible law, and decisive action may need to be taken after the season has fairly opened.

As the sockeye catch has seldom, if ever, been equal to the demand in the waters of Washington, it is improbable that there has ever been a serious, if any, waste of this species south of the boundary. While the traps may secure exceedingly large catches at times, the methods of keeping the fish alive have prevented loss, except perhaps in some cases where they have had to be transported a considerable distance by scows. The discarding of the humpbacks taken in the traps with the sockeye after removal from the water causes much destruction of that form, which seems at present to be unavoidable.